GAME MANAGEMENT MANUAL

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INDEX

INTRODUCTION

This manual contains a brief summary of the principles and practices of game management, particularly as applied to the management of game in British Columbia. It has been designed to serve primarily as a reference and guide in dealing with game management problems, and it is hoped that in serving this purpose the people engaged in wildlife work in British Columbia will find the time and occasion to read and to refer to it. Wise use of the game resource can be achieved only through a co-ordinated approach to the many problems of management. This is especially true in a Province the size of British Columbia where widely scattered members of the Game Branch, both biologists and game protectors must of necessity play an individual role in dealing with game management problems. If this manual succeeds in creating a co-ordination of approach among those engaged in game management it has served its purpose.

THE EVOLUTION OF GAME MANAGEMENT

Aldo Leopold, one of the founders of modern game management in North America, describes game management as "the art of making land produce a sustained annual crop of wild game for recreational use". Other definitions of game management have been made using different words, but with fundamentally the same meaning: that game is an annual renewable resource to be managed for maximum use and enjoyment by mankind.

The management of the game resource has evolved through a series of stages in North America, which represent a natural evolution of events dictated by social and economic conditions. In the pioneer days game was a source of food for the settlers and prospectors who first populated the land. As settlement and other human activities increased, so did the demand placed on the game resources. In many of the more heavily settled areas of the continent a period of uncontrolled use of game followed this era, during which certain of the less adaptable species suffered, and in some cases, vanished. The buffalo, bighorn sheep, and other species in various regions of the continent provide an example of this happening which resulted in a public demand for the protection of wildlife. With its low human population and vast areas British Columbia did not pass through the period of uncontrolled or destructive use of its game resources. The beaver is a possible exception to this but in most cases the days of early settlement and lack of game laws did not result in the reduction of game as was evident elsewhere on the continent.

While some species admittedly suffered through the activities of man, other animals benefitted. The extensive burning of forests, clearing of land, and production of crops, created changes which resulted in widespread increases in the distribution and numbers of such game animals as deer, elk, moose, farm game, and other species of wildlife, while at the same time public demand for the protection of game became recognized. The conservation or preservation hysteria which originated in the states to the south spread to our Province with the result that game laws were drawn up well before our game resources could become endangered.

The foregoing combination of events resulted in the beginning of a period of "restrictive" game management. Game seasons, bag limits, and later, bounties on predatory animals, buck laws, game reserves, and other measures were applied to restrict the utilization of the game resources. During this period, which supplied needed protection to many game species, game populations began to respond to the changes and protection given by man and in many cases increased beyond reasonable numbers. About this time many observers found that despite the rigid protection given to the game, the numbers of animals reached a level that was controlled by other than human factors. Game populations showed wild fluctuations and other signs of distress in many regions which were in no way related to the use of the animals by hunters. During this time many observers began to reconsider the

value of "restrictive" management which allowed game populations to establish new ranges, to increase and decrease independently of human factors, and in many cases to compete with established human enterprises. This new line of thinking gradually became documented with observations and studies and resulted finally in the concept of game management defined earlier in this section.

With the development and documentation of the modern concept of game management, many changes have and are being made in the principles and practices of game resource management. These changes include the initiation of more fluid seasons, liberalization of bag limits, research studies, and other measures designed to improve the utilization of the game resources. Economic and social trends are placing more and more demands on the game resource, which in turn demands more intensive management and protection based on the concept of value through use.

In many regions, steps other than the manipulation of seasons and bag limits must be taken to properly manage and protect the game resources. To accomplish this, the land producing the game must be protected. Uncontrolled use of game ranges by agricultural and other interests may pose a threat to game populations, and may, through competition, reduce game to the status of vermin. Pressure from increased population and development have created this condition in many regions which can be met only through an assessment of values and the establishment of co-ordinated land use which recognizes the requirements of game populations. The large waterfowl refuges established in the United States provide an example of this form of game management and protection.

Within the boundaries of our Province we have examples of the evolution of game management. Thus in the southern regions of the Province we have a more intensive management and utilization of the game resource while in the more remote regions the demand for management of the game resource is less intense. Despite this regional variation the heavily utilized game populations are providing a sustained crop of game.

It is important that we make use of our game resource for only through its utilization will we be able to demonstrate its value and thus justify its protection in the face of increasing population and land uses. In reality, game management is only in its infancy in our Province. Demand has not yet reached the point where the land can be managed for wildlife and made to yield a maximum crop. Most of our game is produced on land that is dedicated primarily for other purposes such as logging and agriculture. We cannot say therefore, that we are practicing the art of making the land produce a maximum crop of game. Since we do not have the public demand for this type of intensive game management at the present time we must be content with managing what the land presently produces of its own accord. Maximum perpetual yield from land as it now exists rather than land manipulation marks the present level of game management. No doubt game managers of future British Columbia will have a greater opportunity to practice the type of management defined by that great writer and wildlife manager, Aldo Leopold.

GAME MANAGEMENT AND JOINT LAND USE

The Value of Game as a Natural Resource

The value of game as a natural resource is relative to the type and extent of its use. The production of game, the extent of participation in its use, the status of game populations on the land, and the econonic contribution of the game resource are factors affecting the assessment of values.

In the past 10 years the hunter population of this Province has doubled in numbers and the annual crop of game has increased by more than this proportion. The following Table of statistics from the 1955 economic survey of hunters in the Province provides a measure of the econonic contribution of the game resource. (Table I).

TABLE I - Expenditures by hunters

Place of residence	Transportation accommodation fees, guides	Equipment	Miscellaneous	Total
Vancouver Is.	$ 843,000	$ 615,000	$ 679,000	$ 2,137,000
Lower Mainland	1,489,000	1,739,000	1,051,000	4,279,000
Interior	1,070,000	1,069,000	803,000	2,942,000
Kootenays	249,000	593,000	217,000	1,059,000
Non-residents	1,172,000	63,000	40,000	1,275,000
TOTAL	$ 4,823,000	$ 4,079,000	$ 2,790,000	$ 11,692,000

As shown in the above Table, the money spent in the pursuit of game is disbursed in rural areas where it is needed. Here, game is a cash crop of major significance.

The increasing size of the annual game crop is a further measure of the value of the game resource, both in terms of meat and in the recreation and aesthetic appreciation supplied. Game harvests in B. C. have shown a steady climb in recent years as illustrated in the following Table (Table II).

TABLE II - Annual estimated harvest

Year	Estimated number of animals bagged		
	Deer	Moose	Elk
1953	28,100	5,300	1,100
1954	34,300	5,300	-
1955	50,900	6,200	1,70[illegible]

Beside the annual harvest of game by hunters, the resource supplies an appreciable contribution of food to people in remote areas. In fact, many of the native population as well as trappers, prospectors, and subsistence level farmers throughout the Province depend extensively on game as a source of food.

A major economic consideration in evaluating the game resource is the fact that game is often largely a product of otherwise useless land. This is especially true in a Province such as B. C. where the topography is often so rugged and mountainous as to limit the agricultural and developmental potential of the land.

Apart from its economic value wildlife possesses an aesthetic value which, although difficult to appraise is, nevertheless, very real. It has been said that there are two main objectives in life: that of gaining a living, and that of living a life. To humanity both are of equal importance and in pursuit of the latter the part played by the wildlife resource is one of some prominence and one which will become increasingly so as the economic future of the Province trends toward industrial development.

Relationships Between Game and Economic Developments

Because game is a product of environment, changes in the environment, created by human or natural forces, can be expected to affect game populations. Human economy is the greatest force effecting changes in game habitat in the Province and gives rise to many situations of compatability and conflict between the game resource and economic expansion.

Agricultural development is one of the most extensive and complex forces affecting game populations. Depending upon the type and extent of the agricultural and game resources jointly using the land many factors must be assessed in determining the proper status of each interest in situations of conflict. The following paragraphs outline briefly some of the major relationships between agriculture and game and although the assessment of these relationships is not considered, it should be remembered that in practice a policy of joint land use is followed.

Livestock and Game - Since domestic stock and most of the big game species have somewhat similar range requirements situations often develop where both types of animals occupy competitively the same range. Usually such competition occurs on game wintering areas which are critical to the survival of game but not to the winter survival of livestock. Again, in areas where mountain summer ranges are not available to livestock and livestock is turned out to summer on game winter range such competition may be at the expense of game unless an equable joint use plan is considered in the range stocking programme. In most regions of the Province the grazing of livestock is not a serious factor in the survival of game and in these areas the mutual use of range by game and livestock is good resource management.

The most frequent forms of conflict between wildlife and livestock may be classified as follows:

(1) Competition for range - Usually competition for range is a result of excessive use by both game and livestock, or by either, on game winter ranges. In the assessment and correction of this type of situation, it is important to consider the fact that the winter ranges are critical to the survival of wildlife populations but not to the survival of domestic stock which can be sustained by artificial feeding. For this reason, competition usually places the greatest burden on game populations.

Competition between game and livestock may also vary according to the species involved, the geography, climate, and the degree of utilization received by the range.

Most big game species, except bighorn sheep, feed primarily on browse during the winter, whereas livestock summering on game winter ranges feed principally on grasses. Proper use of ranges by livestock ensures that grass is not consumed in excess of its rate of production and confines use to the period of the year during which grazing will not damage the survival, or sustained production, of grasses. Under this type of range use by livestock there is little occasion for competition between the two land-use interests. At times range users may subject ranges to excessive use by livestock, causing the displacement of desired perennial grasses by annual grasses and plants of short seasonal duration and inferior quality. Such displacement of grazing elements causes domestic animals to utilize browse, thus competing with the winter requirements of game species.

Range location and local climatic factors influence the degree of competition which can occur through excessive use. In mountainous regions with poor access to summer ranges, livestock may forage all season on relatively restricted game winter ranges, thus predisposing competition. Similarly, in arid regions the seasonal production of forage on overused ranges is shortened, thus extending the tendency and period of browsing by domestic animals.

Improper distribution or herding of livestock on a range may also contribute to joint competition since both game and domestic animals tend to concentrate in certain areas. This may be critical to the survival of wildlife. An example of this may be found around water holes, "licks", and other small areas where the animals tend to collect.

Bighorn sheep and domestic livestock competition present a special problem since the range requirements of both types of animal are very similar. Bighorn sheep require winter ranges with a supply of perennial grasses which, if subject to excessive use by livestock, may be displaced by annual grasses and forbs which will not provide winter food for sheep.

(2) Damage to cultivated and stored feeds - A very frequent source of complaint by ranchers is the damage by game to hay stacks,

alfalfa, and hay crops. Damage to hay stacks can be prevented through the construction of adequate fencing. Good initial fencing practices will often prevent game damage. For example, a fence which will keep an elk or a moose from a stack at the start will not necessarily keep it out after it has become accustomed to feeding on the stack. Slab fences serve well in preventing game from gaining access to stored feed and in most areas an adequate supply of slabs can be obtained for only the cost of transportation. The policy of the Game Branch in dealing with complaints of this type is to encourage the rancher to construct such fences. To this end considerable public relations is needed.

Damage to growing feed crops is difficult to control since large acreages cannot be economically fenced. Usually the game populations are dispersed on summer ranges when agricultural crops are growing, thus reducing the extent and incidence of this form of conflict. White-tailed deer sometimes create problems of crop damage where the range of this species coincides with ranching and control is difficult. One of the best measures of control is the adequate harvesting of game. Repellant chemicals and other measures such as "scare devices," etc., have little effect except for short periods of time in reducing damage to crops by wildlife.

Wise use of land is the best method of producing game and agricultural crops jointly. Serious damage to crops usually occurs on marginal lands dedicated to small acreages of feed production and to eliminate game for the protection of crops of consistently low yield is poor economics. Similarly, in areas where feed crops are grown extensively and productively damage by game demands control.

In summarizing the relationships between game and livestock on ranges it is well to point out that joint use of ranges is good management. Game will utilize areas of a range which for numerous reasons may be inaccessible to livestock, and similarly livestock will utilize range areas which game tends to avoid. The employment of both types of use under conditions of proper stocking will effect an increased range yield and will further the efforts towards good economic use.

Farming and Game - Unlike the generally compatible situation in the production of game and livestock jointly, the production of horticultural crops and big game on the same land usually occasions conflict. In most instances the horticultural development of lands removes big game habitat, thus removing the population of animals which would cause crop damage. Situations arise however, where small areas of land near or on game ranges are put to horticultural use, thus creating conditions which promote the probability of crop damage.

Control of damage to horticulture by game is very difficult to achieve, short of fencing the areas completely. The best system of control is planned land use which prevents the development of this type of agriculture on or near game ranges where game is an important resource and where the agricultural potential is small. In areas where agriculture is established and where it is an important industry, the presence of big game is a liability to the economy and may require re-

moval or rigid control of the population. An example of this is to be found in the Okanagan and Creston areas where game animals cause damage to orchards and other crops.

While horticultural developments may destroy the habitat of big game species, they often provide certain compensations in the form of habitat development for farm game species. Hungarian partridge and other small game species benefit from this type of agricultural use of the land which creates favourable habitat and food conditions. Cereal crops on large acreages of land favour the requirements of Hungarian partridge. Grain crops with ample cover interspersion on small cultivated acreages creates habitat for pheasants and, to some extent, quail. The agricultural areas of the Okanagan region provide an example of this situation.

The dedication of large acreage to dairying and grass production creates unfavourable habitat conditions for most small game species. This trend in the agricultural practices of the Lower Mainland region has resulted in an extensive decrease in upland bird populations.

Generally, the availability of food does not limit farm game populations. Cover requirements however, may restrict them where agricultural development is extensive and where "clean" farming is practiced.

Waterfowl and Other Land Users - Most of the waterfowl producing regions of the continent are situated in areas of agricultural development. This is largely true of the waterfowl producing areas of this Province. The pothole country of the Kamloops and Cariboo regions illustrate this duplexity of land use.

Probably the most devastating effect that agricultural development has on waterfowl production is land reclamation and the drainage of marsh areas. Such drastic modifications of environment result in the immediate and complete removal of waterfowl nesting habitat and the destruction of feeding and resting grounds essential to migratory birds. An example of this phenomenon is well illustrated by the reclamation of the Lower Mainland marshes and Sumas Lake.

Various crops, usually in areas of waterfowl concentration during the fall migration and near wintering grounds, suffer damage from waterfowl, particularly from pond ducks such as mallard, pintail, and baldpate. Mallards and pintails have recently acquired the habit of feeding on swathed grain, particularly short-awned wheat and barley. Baldpate frequently damage green crops such as clover. In certain areas of high duck concentration damage by this type of feeding and trampling may be extensive.

Agricultural methods of growing and harvesting crops can often predispose crops to damage as in the case of production of late maturing crops which may coincide with fall migrations of waterfowl. Similarly, swathing of grain will attract migratory game whereas standing or stooked grain will be avoided by the birds. The location of highly favoured food crops close to established waterfowl concentration points

will often result in damage which might otherwise have been avoided.

The assessment of crop damage by migratory game demands the consideration of these factors and in many instances remedial action can best be achieved through altered crops or harvest methods. The control of depredation by waterfowl is often difficult since the birds are highly mobile and since much of the damage occurs at night. Control is best effected immediately damage occurs or before. The birds become accustomed to flighting to certain fields or areas and a habit pattern is established.

Ranching and range use practices often adversely affect waterfowl production, especially that of the pond ducks. Heavy grazing and poor distribution of livestock which allows the animals to collect around water sources can curtail reproduction of ground nesting species. At times ducks which nest in shallow waters may suffer nest losses through livestock grazing on aquatic plants. Control of this type of competition could be achieved through improved land use planning and the fencing of livestock from nesting habitat.

Forestry and Game - Forests and game are sister crops of the land and for this reason forest management and development have a profound effect on most of the big game species.

Moose, deer, elk, and most of the grouse, occupy habitat created by the removal of climax forests, whereas caribou and some of the fur-bearing species depend on the presence of climax forest types. The removal of forest cover and the resulting regeneration of growth thus creates new habitat for the most important of the big game species. The method and extent of forest removal and other features of forest management practices affect the establishment and utilization of game populations. The major forestry practices and changes affecting game are listed for convenience as follows:

(1) Fires - Fire has been the most extensive and effective agent in creating game habitat in past years. Most of the existing game ranges in the Province were created initially by burning of the forests. The result of a burn in producing habitat for game may vary with climate, the location, and degree of the burn. In dry areas a hot burn may result in the establishment of lodgepole or jack-pine cover which is usually unproductive of game. Re-burning of this cover may stimulate the tendency for jack-pine to establish itself, thus further decreasing the carrying capacity of the area for game. Burns in mixed jack-pine or mature aspen and willow cover may result in the regrowth of a new deciduous cover favouring game.

The burning of climax forests in wet regions usually favours the establishment of cover suitable to game. However, the timber produced in these regions far exceeds the value of any game produced as a result of burning.

The location of a burn may, in large measure, govern success

in the establishment of game. Burns situated within an extensive area of forest may be unavailable to game populations, hence of little value. Similarly, burns situated in areas of deep snowfall may serve little purpose in maintaining a game population. The most effective use of fire as a means of benefiting game occurs when it is employed to improve needed winter or summer ranges.

(2) Logging methods - The type of forest management practiced in an area can have a marked effect on the game populations. For example, selective logging of mature trees in a forest does not open the ground for the creation of game habitat. Clear logging of forest stands will, on the other hand, open the ground to the establishment of extensive areas of game range. Examples of these two methods of forest management and the effect on game populations may be seen by comparing the forest management practices on the Lower Mainland and Vancouver Island with those practiced in the Interior dry belt regions.

While game populations generally benefit from logging and burning of forests, excessive populations of game animals may cause damage to forest interests. Deer, moose, elk, and grouse, may damage seedling trees in a planted or regenerating forest. Problems of this nature are well known on Vancouver Island where both deer and blue grouse damage plantations by eating the terminal buds of young trees.

The most effective and least expensive method of minimizing this type of damage is proper use of the game resources. When game populations are maintained in balance with their habitat, damage of this type rarely becomes an economic factor. Chemical and other types of repellants have had limited success and are expensive to apply in controlling this type of damage.

Industry and Game - Most of the industrial development of this Province has had little or no effect on game populations. However, this does not mean that future industrialization could not be of a type or in a location detrimental to wildlife populations. Hydro development has probably the most extensive area of influence and is probably the most direct in its effect on game. Winter ranges of big game may be flooded, waterfowl habitat may be destroyed, and some of the secondary development such as irrigation may displace game populations. In most areas so far developed for hydro-electric power game populations have not been drastically affected and usually the relative values involved places game requirements low in priority. Chemical and mining industries may create problems of toxic wastes being discharged into watercourses, lakes, or marshes of wildlife importance. However, this type of competition is relatively rare where game is concerned. Control of such damage is usually accomplished by the impoundment of the waste products.

Access and Game - Access to game populations and the utilization of game is just as important as the existence of game. Access is perhaps one of the largest single problems involved in the management of the Provincial game resource and is probably one of the most

direct results of the many activities of man on the land. Problems in access accompany all types of development whether it involves agricultural, industrial, or other fields of enterprise.

Access is particularly important where human activities favour game populations. Thus access to forest management areas and to agricultural lands is vital to the proper management of the game resources associated with these developments. In most cases where game creates damage problems, the best system of control is the proper cropping of the game populations. To achieve this good access is a necessity which benefits both the development concerned and the user of the wildlife resource. This fact has resulted in public access to much of the private forest lands on Vancouver Island where large deer and grouse populations may damage tree plantations.

The mountainous topography of this Province accentuates access problems in many areas as a result of ribbon development along roads and valleys. Provision should be made at all times for the assurance of public rights of access to game populations which may be located beyond presently developed areas.

GAME MANAGEMENT PRINCIPLES AND POLICIES

Fundamental Population Dynamics

In order to make the best possible use of the game resources one must have an appreciation of the principles underlying the natural fluctuations of animals. Anyone who has studied and observed plants or animals for any appreciable time will have noted fluctuations in numbers from year to year. A static or unchanging population is a very rare exception to the rule, in fact it is very doubtful whether it ever persists for any appreciable time in nature.

In order to understand the reasons for changes in population numbers one must realize that any animal is the product of its present environment and of countless years of evolution through previous generations. Changes in the environment whether short or long term will be manifested in relative changes in the individual of the population and also the size of the population as a whole.

The environment of an animal consists of an aggregation of all the external and internal factors affecting the existence, growth, and welfare, both positive and negative of that animal. The environment of a population consists of everything with which the population comes into contact during its existence. The internal parasites of a deer are just as much a part of its environment as the air about it, the food it eats, or the cougars and coyotes that prey upon it. It may be seen then, that all living things affect the lives of all other living things within the same biological community.

There are, in every biological community, factors favourable and factors unfavourable to any animal or population. The favorable or welfare factors that promote growth of a population are the inherent ability of the species to reproduce, food, cover, water, favourable climatic factors, and last but not least, space. Unfavorable or decimating factors are disease; parasites; predators; starvation; lack of water, food, or cover; inclement weather; and crowding with resultant strife.

The factors affecting the status of an animal or population do not act with consistent force upon individuals or populations of different species or even different populations of the same species. The dominant controlling factor in one population could be lack of food; in another, diseases or parasites; and in a third, merely lack of space.

Population Behaviour

A very close analogy can be drawn between a population of animals and an individual animal. In both cases they start out small, grow slowly at first, grow rapidly during the mid stages of development, and virtually cease to grow at maturity. Eventually they both die, usually to be replaced by succeeding generations or populations

of the same species. Populations sicken, revive, and regain former vigour as do individuals.

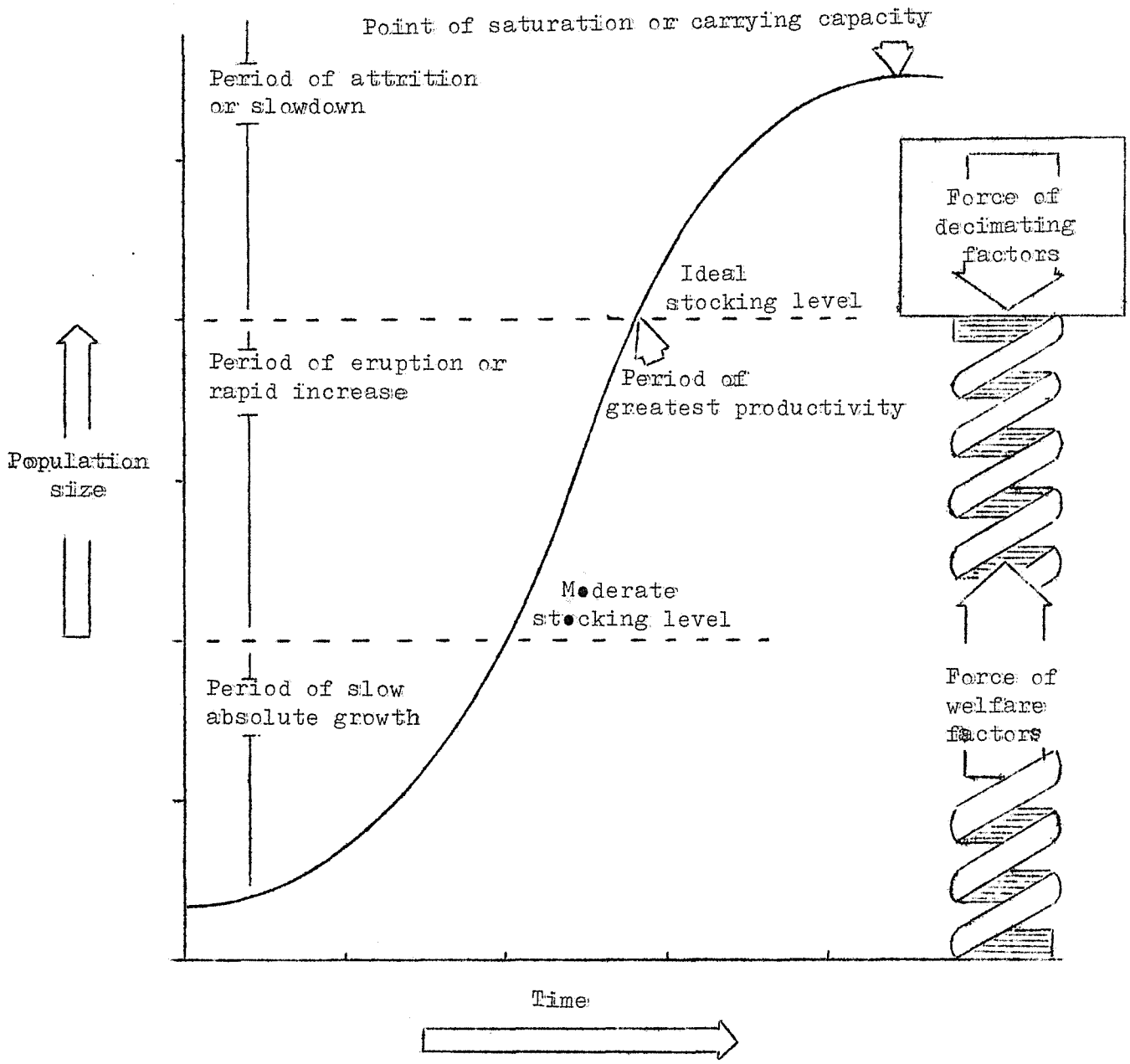


Figure 1 - The growth curve.

Figure 1 is a graphic illustration of a growth curve. It illustrates how a population increases from a point well below the carrying capacity of its range up to the saturation point. Such a curve would be representative of the population increase following a successful introduction of a species to a new environment, the population increase following the immigration of a species into a new range, or the introduction of an improved environment to a species already present. It is also characteristically the pattern of a cyclic species when the population is "blooming".

Most populations vary about a point between that of ideal stocking and saturation. The size of any population depends upon the relationship between the downward "force of decimating factors" and the upward "force of welfare factors." This "force of welfare factors" is powered by the total growth-promoting factors of suitable weather; abundance of food, water, cover, and space; natural vigour; and high natural reproduction. The force opposing this pressure to increase is the sum total of conditions adverse to the species. These conditions are: prevalence of disease, predators and parasites, inclement weather, poor nutrition due to failure of the seasonal growth, or lack of space with over-crowding and the resultant lowering of the reproductive rate due to loss of vigour, or any combination of two or more of the above mentioned factors. While these two opposing forces act in opposite directions they are at the same time closely related. In fact, the weight of decimating factors is composed largely of factors originating within the population itself. Disease, parasites, and competition are good cases in point. Hence populations tend to be self limiting at the saturation point.

Older theories on the behaviour of populations were based upon a static balance of nature concept. This concept envisaged all animals in a very delicate balance, births just equalling deaths, and wherein increased losses or deaths due to man's interference would result in the species' eventual plunge to extinction. We now realize that such theories were based upon erroneous information or false logic.

Recent studies of animal populations indicate that all populations are striving to fill their environment to capacity, (man is no exception), and that potential productivity far exceeds probable losses until the population reaches a saturation point in relation to its environment. Were this not so, no population would ever increase. Animal populations tend to be at capacity at all times. Present day hunting seldom, if ever, takes more than a proportion of the annual increase and the remaining part is sufficient to maintain the population and to fill vacancies in the habitat that result from yearly fluctuations due to hunting or other causes.

In almost all cases, serious losses of game bird or animal populations can be traced to habitat changes. These changes may be due to land use practices, competition with domestic stock, fires, logging, climatic changes, or other causes natural or man-induced, which result in a lowering of the carrying capacity of the area for the species in question.

The saturation point or carrying capacity is that point where decimating factors equal growth-promoting factors (see Fig. 1). The population bucket is full. Where decimating factors exceed welfare factors a population decline results. The bucket has shrunk and won't hold as much as before. Members of the deer family for example, are capable of eating out their range with the result that carrying capacity shrinks and the population declines accordingly but is <u>still at capacity</u>

Where winter range conditions are the prime controlling factor, carrying capacity will vary from year to year according to the severity of the winter. Here we have no static or easily recognized saturation point. The carrying capacity may vary from year to year and from period to period through an almost infinite variety of causes, hence the variability of the size of animal populations over periods of time.

It is easy to demonstrate that a dense population of deer or moose living on an overused range is at capacity. Food is the most obvious of the controlling factors. Lack of food is usually accompanied by parasitism and disease which are secondary to malnutrition. It is far more difficult to demonstrate that a sparse population living on a virtually unbrowsed range may be at capacity too. In such a case those factors controlling the population are equally as effective as food shortage was in the first instance. It may be that winter snow depth, lack of continuity of suitable habitat, or a variety or complex of factors control the population. No matter how obscure the factors may be, the fact remains that they exist and operate on the population; otherwise it would continue to increase.

It would require many years of intensive research to determine the capacity of each range for each species of game. The behavior or condition of the population itself indicates best the state of the population and its relationship to its environment. Most game animals have a high potential rate of increase given suitable habitat. The full measure of this ability to reproduce will only be apparent in understocked ranges or when part of the population is removed each year. Once the population reaches the saturation point in relation to the capacity of the range this rate of increase ceases.

It is obvious that fluctuations in animal numbers are largely the result of the population density. One must always bear in mind that the animals themselves are part of their own environment and will react upon one another accordingly and the accumulated effect will be apparent in the size of the population. As a general rule when animal populations are high the trend is towards a decline and when low the reverse or an upward trend is to be expected.

So far we have considered the relation between a population and its saturation point, largely because that is the condition of most of our game populations. From the standpoint of management for greatest yield, the most important point in the population growth curve is the highest point in the period of eruption. This is the period of greatest productivity (see Fig. 1). At this point the animals are well fed, have high vigour, competition is slight, and they produce the greatest number of offspring and survival to maturity is highest. A population at this point enjoys the full benefits of all available welfare factors and suffers few of the decimating factors which operate on the higher densities or at the saturation point.

The only practical method of ascertaining the eruption point is to continually liberalize the harvest until hunting becomes the prime controlling factor. By doing this we merely substitute harvest-

ing for the decimating factors contingent with a saturated population. We should attempt to keep game populations erupting at full vigour at all times in order to obtain the greatest returns from the resource.

While it is obviously pointless to attempt to promote game populations in excess of saturation, it is also poor practice to try to maintain them at saturation. In most cases excessive numbers of animals cause environmental deterioration due to depletion of the food supply, excessive contamination with parasites and diseases, and also stimulate a build up of predator populations, all of which take their toll of the annual increase. Frequently the final result is a serious decline in numbers.

The fact that a population is static or even decreasing does not mean that a harvestable surplus does not exist. Very frequently the decline is due to deteriorating range conditions. By harvesting animals, tension is reduced within the population. Vigour improves and reproductive success increases. You may never be able to support as large a population as previously but by cropping you can keep it reproducing and maintaining a harvestable surplus. Moose populations in certain sections of the Cariboo and Chilcotin are examples of this situation.

Two patterns of population variation are evident. The cyclic pattern, where populations rise and fall in a reasonably rhythmic pattern, and the non-cyclic pattern where population variations appear to follow no regular pattern. Animals exhibiting cyclic population behaviour in B.C. are the interior grouse, varying hare or showshoe rabbit, most of the field mice, and the ptarmigan. Secondary cycles occur also in those predators which rely upon the cyclic herbivores and game birds for sustenance. Lynx cycles are related to rabbit abundance and no doubt other fur-bearers vary in proportion to the number of mice and other prey species.

Although many explanations have been suggested to explain cycles, none appear to fit all cases satisfactorily. The increase in the population follows the pattern of an erupting population which is easily understood (as a population attempting to fill its environment). The subsequent cessation of increase at saturation is equally well understood. The mechanisms causing the crash however, and especially the relative regularity of the crash are still largely unexplained. The regular crashes that occur in a good many species have been observed and the apparent causes documented. In virtually all cases these causes have been parasites, diseases, or failure to reproduce, conditions that are normally associated with capacity populations.

Cyclic species have very high reproductive rates. Rabbits, mice, and ruffed grouse, are perhaps the best examples. The length of the cycle appears to be related to the size of the animal and its rate of increase. Mice which are small animals with a high reproductive rate have short cycles (4 years). Rabbits being larger animals with a lower reproductive rate have larger cycles (9-10 years).

Some biologists have speculated on the possibility that even our big game species may be cyclic with cycles up to 50 years in length. Records at present are inadequate to substantiate or refute such theories and they still remain in the realm of interesting speculation.

We must always remember that fluctuations in numbers whether regular or irregular are the rule in wild populations. Animal populations are always attempting to fill their environment to capacity. Once they do so one phase of the cycle has been accomplished and the next is sure to follow. To quote Durward Allen: "The ideal of perpetual abundance is somethong we like to anticipate, but is largely an illusion. It will be healthy realism to remember that too many animals in a limited area pollute their own environment or in other ways make it less favourable, and the result is as predictable as February. You can't have maximum numbers indefinitely."

We can prolong the eruption phase of a population by merely not allowing it to reach saturation. For the greatest yields a game population should be shot heavily enough to keep it down continually in the eruption phase of the population curve.

The Principles of Harvesting

Wildlife harvests are controlled by a variety of means. Bag limits, seasons, quotas, and the establishment of reserves and closed areas are all used to a greater or lesser extent.

Seasons are set with a variety of considerations. Originally, closed seasons were instituted to protect breeding stock and to ensure adequate reproduction for the following year's harvest. Today, variation in the length and times of various seasons are used for a variety of reasons.

Limit the kill - Where hunter demand is high, access relatively easy, and a population small, a short season is set to limit the kill to numbers compatible with the population. The time of the season is also chosen for the same reason. The season on California bighorn sheep and mountain goat in the Similkameen is a good case in point. They are relatively few in number, are desirable trophies, and available. A short season is set when the animals are scattered and alert. Hunter success is low but recreational values are high and the species benefits from moderate cropping.

It should be noted that in some species such as grouse, ducks, and pheasants, the length of the season has little bearing upon the over-all kill beyond the first two weekends. In other words, the first two weekends, and in particular, the first, account for the bulk of the kill. The greatest number of hunters is afield at this time and in addition, the birds are most vulnerable at the beginning of the season. Split seasons are designed to provide two "opening weekends" and hence, increase the recreation and kill.

Regulate distribution of hunters - The length and type of season is varied in order to regulate the distribution of hunters. Areas that are remote and that support large stands of game can frequently withstand heavier hunting pressure. Longer and frequently earlier seasons are set in such areas to try to attract hunters to them and so reduce congestion in more accessible areas. In this manner the hunters are spread out and better use is made of all game populations.

While seasons may be set to limit the kill in some cases, consideration should also be given to achieving the desired kill. Here we should be concerned with movements of game and access to the hunting areas. Seasons on Vancouver Island blue grouse are more effective if they are in effect before the birds migrate to the higher country. Seasons on Interior moose and deer herds are more effective if they occur before the secondary roads are snowed in.

Primeness of game - Seasons are set at a time when game will be prime so that the best use can be made of the meat. For our big game animals most seasons run past the time when they are prime but this is necessary to obtain an adequate harvest.

Produce the most recreation - Where possible, seasons are set as early as possible. Hunting is most enjoyable in the mild weather of early fall and more people are able to partake of it then. Game bird seasons should be set as soon as the young of the year afford good shooting. The population is then at its maximum for the year and delaying the opening of the season merely results in greater losses of young birds to natural causes.

Economic factors - Economic factors also govern the time of opening seasons. With the growth of a guiding industry, seasons must have a continuity of pattern from year to year to enable guides to book hunters in advance. To date this has led to no great problem.

Seasons on farm game and waterfowl inhabiting farming and pastoral areas must be governed to a certain extent by land use. Seasons on pheasants and ducks should not be set when hunting will unjustifiably interfere with ranching and farming.

Safety - Hunter safety has not been an important factor in the consideration of the type of open season in British Columbia to date what with a combination of large areas, a good variety of game species, and relatively few hunters. It does warrant consideration however, and if possible, seasons should be set to avoid large concentrations of hunters.

Bag limits and sex designation - Bag limits and sex designations, like seasons, were introduced as conservation measures. Bag limits function to limit the kill and to distribute the kill equitably amongst the hunting public. It is unfortunate that bag limits frequently work to the detriment of the keener and more efficient hunter without performing a useful function. This is especially true in remote areas. However, were they not instituted, available and vulner-

able species of game would possibly be damaged and the kill would be less equitably distributed among the hunting public.

Bag limits also control the type as well as the number of head of game harvested. Buck laws, bull laws, and "cock only" seasons are justifiable when populations are well below the desirable stocking limit. Once this stocking limit has been reached a portion of all sex and age classes become surplus and open seasons on them are justified.

The regulation restricting harvest of California bighorn sheep to those carrying horns with three-quarter curl or better is designed to ensure a supply of rams of breeding age on one hand and to allow the cropping of trophy animals on the other. While such a ruling will not produce the greatest quantity of animals, it will ensure that trophy animals will be available. Under such a conservative ruling there is virtually no probability that the population can be damaged. This is one instance of good population management being incompatible with the best use which is for trophy purposes. The few trophy or three-quarter curl sheep killed is below the number that should be taken if the annual surplus is to be removed and the population kept below the saturation point.

Habitat Management

As previously stated, a population of birds or animals is largely the product of its environment. This fact has long been recognized by experienced hunters who seek out areas of suitable habitat in which to hunt. Wealthy European land owners have long practiced habitat management in order to promote larger populations of game. While the ideas behind habitat management are biologically sound they are all too infrequently economically sound, particularly in British Columbia at the present time. As future demand for hunting increases however, land management for wildlife which is management in the true sense, may become a reality.

Habitat improvement to be effective must be maintained on a permanent basis. It must be a practice mutually acceptable to the joint users of the land resource and readily integrated in long-term multiple-use management. In some situations it is essential that habitat maintenance or improvement be the primary concern of land use in which case Departmental ownership of such areas is virtually mandatory. Until game range areas can be held in the name of the Department or until the wishes of game management are given consideration equal to those of associated land users, habitat management can not be developed practically or economically to its most effective level.

Wilderness game - Habitat management in the field of wilderness game entails the modification of large areas of range. The only tool at hand that can do this economically is fire. While there is no doubt that many of our good game ranges are the by-products

of past fires, it is also true that many old burns are valueless as game range or anything else. It must be realized that no two fires produce the same results. The results of a fire depend upon a great number of variables. Some of these are humidity and moisture at the time of the fire, soil type, aspect of site, density of forest stand, type of stand, slope of site, size of fire, and many other factors. A second fire will not produce the same conditions as the original burn. Soil, drainage, and cover have changed and the results will inevitably be different.

The proponents of burning as a tool in game and range management point to those areas where benefit has resulted from the use of fire. Naturally since burning has never been attempted officially for the purpose of improving game range most of the present day haphazard burns are of little use to wildlife. This is unfortunate because when used with a purpose in mind fire may well be a useful tool in range management.

Logging has resulted in the greatest change in wilderness ranges in recent years. While it cannot be classed as deliberate or planned habitat management it does modify habitat and is therefore important. At low altitudes, logging frequently results in improved game range. Removal of a large portion of the canopy of mature trees allows more light to reach the forest floor. This results in an increase in the growth of grasses, herbs, shrubs, and young deciduous trees most of which contribute to the food supply of game.

Farm game - Habitat management for farm game is somewhat equivalent to farming and costs are high. Returns must also be high and the demand great in order to justify the effort and expenditure involved. Unfortunately, this is very seldom the case. At present, the very best one can hope to accomplish along these lines would be to encourage farmers to protect and perpetuate existing cover, hedgerows and groves of trees, and to leave standing grain along field edges for winter feed. The problem of farm habitat improvement involves monetary returns to the landowner. The landowner cannot be expected to expend time and money on improvement of game range unless he can benefit directly therefrom. Until farm game can be demonstrated to be a financial asset there is little hope that the average farmer will take steps to improve conditions for it.

Waterfowl - Habitat management can probably be most rewarding in the field of waterfowl management. Here we are largely in the preservation rather than the production stage of management. If is essential that critical areas of waterfowl habitat should remain waterfowl habitat. Duck Lake at Creston and large areas of the Fraser delta marshes are good cases in point. There are too, many small areas of waterfowl habitat that are threatened by some other form of land use and every effort should be made to preserve them when at all practical. Remember, land that is occupied by wildlife is being used. It is sometimes held that land is not used until it supports or provides some more tangible asset such as farm crops or trees. Wildlife is often a sufficiently important land user and it should receive recognition as such.

Winter Feeding

Big game - Whenever concentrations of big game occur during severe winters requests are received to feed the starving game herds. Although feeding programs have been carried out in widely separated areas of Canada and the United States they have never been an unqualified success. Experience has shown that few game animals thrive on hay alone, and that feeding stations merely tend to concentrate hungry animals attracted to a free "handout." This results in an "eat out" of the natural browse in the area close to the feeding station and no permanent benefit to the population.

Costs of feeding big game are usually prohibitive, both from the aspect of total cost and cost per animal fed. In addition to the animals that might need to be fed many animals will be attracted to feeding stations that would have wintered quite well on their own. Feed supplied these animals is merely wasted from the point of view of economy.

The State of Wisconsin carried out extensive deer feeding programs for a number of years. They found that when feeding alfalfa at $40.00 a ton and adding transportation charges it cost approximately $10.00 a head to feed a deer for a 90-day period. Such a figure does not appear unreasonable at first glance. Surely a deer is worth $10.00!! But when it is realized that for every deer taken one must support from 5 to 10 deer in the herd it is apparent that it would entail a cost of $50.00 to $100.00 per deer harvested. It is most doubtful that even the strongest proponents of deer feeding would be willing to pay a licence fee of $50.00 per deer to defray the cost of winter feeding.

Feeding of big game can only be justified in rare and peculiar circumstances. When an introduction of animals has been made to a new habitat supplimentary feeding may be justified until the animals become thoroughly familiar and adjusted to their range. When animals are trapped by deep snow or crust, cutting of natural browse will frequently relieve the distress of a limited number of animals. Such activities are justified to help local populations of animals.

Cruel though they appear, hard winters have compensating effects upon big game populations. Severe winters cull the herds; the unfit are eliminated and only the strongest stock survives. This vigorous stock rapidly repopulates suitable ranges when moderate winters follow severe ones.

The alternative to winter feeding is judicious thinning of the herds by cropping. In this manner we shall realize more in returns from our big game herds and at the same time reduce suffering due to malnutrition caused by over-crowded ranges. Some losses are always to be expected during even moderate winters. The very old, the diseased, and the weaker young, will be removed and the vigour of the bulk of the stock so maintained.

Game birds - The winter feeding of game birds, except in conditions of deep, crusted snow cover, is seldom necessary. In application it is generally impractical and in results, largely ineffective. Those who have engaged in winter feeding of pheasants in British Columbia will appreciate the large number of feeding stations needed to ensure adequate coverage of an area. This service must be maintained throughout the emergency period and to be assumed effective, it must also be assumed to have assisted the majority of the wintering population. The concentrations of birds about feeding sites is often accompanied by increases in losses due to predators attracted to the area. While a few birds may be benefitted to some extent by winter feeding it is very doubtful that the practice can be undertaken on a scale great enough to improve significantly the over-winter survival of a resident game bird population in any major locality.

Game Propagation

The practice of game propagation is one of the oldest artifices of game management. It may include such endeavours as the artificial production of game on game farms for annual stocking in the wild, the artificial assistance to winter survival of certain species by augmenting the natural food supply, artificial assistance to the natural reproduction of some game birds by the creation of suitable safe nesting sites, the transplanting of species from a native range to similar unoccupied ranges, and the artificial manipulation and improvement of game environment.

In B. C. the most extensive and intensive efforts towards game propagation have centered about the introduction of exotic species, principally game birds. There are numerous factors to be considered when the introduction of exotics is contemplated. The habits of the animal itself must be known to avoid the establishment of a species that might become an economic pest or a serious competitor with native species. A knowledge of the native requirements of the exotic must also be known lest it be planted in areas environmentally intolerant to it. One of the first appraisals should be directed towards the quality of the species as game and whether or not there exists an unoccupied ecological niche that might support it. Too often well-meaning people motivated by the wish to see something new or the desire to duplicate hunting they have known in other lands press for introductions of exotics without sufficient consideration of the problems or consequences. The native game fauna of this Province is extensive and varied and unless it can be successfully cropped and managed there is little to be gained through ill-considered importations of exotics.

Artificial stocking of farm-reared birds has been employed for many years in this Province and has been confined almost entirely to exotic birds, principally the ring-necked pheasant. Also included in the list of introductions are capercailzie, black game, Hungarian partridge, turkey, bob-white, California quail and chukar

partridge. These plants were made initially to establish the species and were continued annually, in the case of pheasants, to augment the wild population.

The reasons once believed sufficient to justify these large and costly annual releases were: (1) to provide directly more cocks for the hunt; (2) to provide more hens for subsequent production; and (3) to improve the population by the addition of new blood. Considerable study of pheasants locally and generally within the Province has shown that the direct contribution of released cocks does not improve the annual harvest significantly and that the releasing of hens is of doubtful value in assisting wild production. Insofar as adding new blood is concerned it would appear to be quite unnecessary. In fact, the wild populations which have developed over the years in the face of natural selection are probably much hardier and better constituted genetically than are the mass-produced, artificially reared birds.

From the economic viewpoint the large sums spent annually for the artificial stocking of pheasants are not accompanied by improvements in pheasant abundance to the extent that the practice should be maintained.

Transplanting of captured stocks of native game species is another form of game propagation and may be justifiable and desirable. The purpose of this practice is to introduce native fauna from an area to which it is native to other areas ecologically suitable but which have not been populated by the species previously due to geographic isolation or other barriers. In some situations where relatively small remnant groups of a game species exist at a low population level it is often necessary to trap and transplant a breeding nucleus of animals to some distant and favourable range in an effort to perpetuate the species as a population. This has been done with California bighorn sheep and other groups in certain parts of the Province and should continue as a justifiable management practice.

Experiment and Research

All game management has evolved from some form of experimentation and research, and the welfare of present game populations and the maintenance and improvement of future hunting in the face of constantly increasing hunter demands will require even more intensive study.

Research may vary in scope and field and may be defined broadly as the search for facts upon which revisions of accepted conclusions may be made. Such a definition may disappoint many who feel that research is something (involving much technical equipment) applied to some generalized problem with an inevitable and positive solution being obtained. In some instances where the problem may be well defined, research may often provide an early and direct solution. However, it is the long term, basic, research programs which consume

time, money, and individuals, with little or no apparent results that have contributed most to the advancement of game management in the past and will no doubt continue to do so in the future. Game management research by the Department to date has of necessity been restricted to cursory appraisals and investigatory work of an immediate nature. There have been however, a number of experimental research projects undertaken with results of practical value during the past 10 years.

Studies of banded birds, including waterfowl, pheasants, and grouse, have been carried on almost annually since 1947. Much of significance to game management has resulted from the banding programs. Life history studies of blue grouse and Barrow's golden-eye duck, research on orchard sprays and other factors affecting pheasants have also been undertaken. On big game species much work has been done on moose, deer, and sheep populations and information derived from these investigations has been of considerable value in recent management of these animals.

There is much yet to learn about the physiology, behaviour, and ecology of game animals, and much work to be done in the development of management techniques, in the study of moose, hunting pressure, and harvest. And if what seems today to be a truth is shown by later research to be false, game management will progress -- if it will apply the new knowledge. One of the biggest problems in game management, apart from those of research itself, is that of overcoming an antipathy towards the application of the new ideas developed through research. The progress towards the ultimate solution of a problem can only proceed through new knowledge and the use of that knowledge. It is essential therefore, that research be accorded an open mind by those who employ it if the expense of this phase of game management is to be justified and ultimately successful.

Game Reserves and Closed Areas

The intended purpose of a game reserve is to conserve the wildlife populations present within a specific area through protection from hunting. Existing knowledge of the dynamics and behaviour of game populations is evidence that game reserves, with few exceptions, are of less value than is implied in their title. The popular conception of such a reserve envisions an area free from human depredations in which such protection will permit a regular and cumulative expansion of the various game populations. In actuality the anticipated benefits of such protection seldom materialize. The basic natural forces controlling populations do not discriminate between protected and unprotected situations and their influence is not diverted from an animal group through the arbitrary creation of a sanctuary. In fact, there is much evidence to show that the impact of natural forces on "protected" game populations may be more severe than on those subject to annual harvest.

Game reserves, like any unprotected area, have a harvestable game fraction which should be taken and in times when there is need to distribute hunting pressure the contribution of game reserves in absorbing part of the pressure and adding to the game harvest are real considerations.

Man's harvest of game is only one of a large complex of factors acting upon the animal population but because it is perhaps the most conspicuous and more easily controlled, it is often erroneously interpreted as a primary reason for the creation or necessity of the game reserve device. Except for certain peculair situations, game reserves do not fulfil their purpose and should be discouraged as a game management practice.

The general policy with regard to currently existing game reserves in B. C. should be directed toward a critical appraisal of their value.

Closed areas differ from reserves primarily in purpose and permanency. Most closures arise out of local demands by private or organized agencies for protection of human life and property or for the protection of some natural resource including wildlife. Their length of tenure may vary from a few days to periods of indefinite or permanent restriction. From the viewpoint of wildlife management they are essentially undesirable as they restrict the effective harvesting of the game resource. Proposals for the closing of certain areas should always be given critical examination and, unless valid reasons for initiating such restrictions are evident, they should be discouraged.

Public Relations

Game management is essentially a public service involving the maintenance and development of an important natural resource. As it covers a field of activity shared by a substantial element of lay opinion and a variety of separate land use agents it is essential that cooperation and understanding between these groups be promoted to ensure a climate most favourable to the development of wildlife interests. Good public relations is not the responsibility of a special branch of the Department of Recreation and Conservation but is rather the duty of every individual member. Game management is a relatively new science and one which subscribes to principles much opposed to some of those on which early game conservation was based. Hence, it is to be expected that opposition to current management practices is at times a problem. This difficulty can be overcome largely by public education undertaken by every member of the Game Branch. <u>However, such education can only be effective if the ideas advocated are supported in thought and action by the entire Game Branch staff</u>. It is essential in the educating of the public that the educators be in agreement on the principles of good management.

In the prevailing period of intensive development and exploitation of the natural resources of the Province by organizations and private individuals it is inevitable that competition for land use will jeopardize the best interests of the wildlife resource. Public opinion can be a strong influence in ensuring equitable treatment for wildlife and in establishing it in its rightful position in the field of multiple land use. The best way to obtain this support is through a public which is well informed of the aims and needs of game management. Again, it is our collective effort to bring these aims and ideas before the public that will best accomplish the task of education.

Farmer-sportsman dealings form an important component in the field of game management public relations. While of necessity the Department can not support either group, it can through its neutral position, often bring about successful mediation in farmer-sportsmen problems. It is definitely to the interest and advantage of wildlife management to stimulate and cultivate the activities of both these groups and whenever possible to provide liaison between them. In many parts of the Province the future of wildlife and hunting rests largely in the hands of the farmer and the sportsman. It is the Department's task to encourage good understanding and good relations between these and any other similar factions.

Predator Control

In British Columbia predator control activities have arisen from the practical need of protecting domestic stock, and in some cases, rare game species and human life. In most instances, benefit received by game populations from predator control work is incidental to other purposes. Adequate cropping of game is more frequently a problem affecting the status of game populations than protection from predators, thus the occasion to control predators for the protection of game is rare.

The intensity of control measures depends primarily upon the importance of the area and the problem at hand. If an area is important because of domestic stock, or is heavily hunted, or contains a so-called rare species, it may be treated heavily in an effort to lower the predator population significantly. Conversely, if an area has little or none of the foregoing attributes control measures are usually not justified.

An exception to the foregoing are the cougar control measures applied on Vancouver Island. Here there have been a number of attacks on human beings during the past few years. In almost every case the attack was made by what is referred to as a "settlement-type" cougar. Cougars with this behaviour frequently invade small settlements along the coast in search of food, usually in the form of domestic dogs and cats. To forestall any possible human attacks it is the policy of the Predator Control Division to destroy every cougar which appears near human settlements.

GAME MANAGEMENT TECHNIQUES

Wise use of renewable resources such as game, livestock, or timber depends upon a background of factual information. While many data collected by wildlife agencies cannot be called accurate in the sense of a bank balance they are nevertheless accurate enough for the job. It is doubtful if stocks of wild animals will ever be inventoried in such detail as a herd of cattle but there is no doubt that stocks of game can be measured to show trends and population size within certain limits. These limits will narrow as new ideas and techniques and increased manpower become available.

Facts and figures about wildlife can be broken down into two broad types. There are those which concern the individuals of a population such as the weights or body measurements and there are those which concern the population as a unit. These latter data may provide an estimate of the number of animals in a population or simply provide an index to animal abundance. For example, we may use the number of moose seen per hour of flying or the number of pheasants crowing per minute of listening as indices to compare from year to year or for comparing one area with another. Although we may have little idea of how many animals are present at any given time, we can tell if the population is increasing or decreasing and by what proportions. Generally, it is much more economical to obtain population trend data than actual population estimates.

There exists a wide variety of techniques for acquiring facts about animals ranging from aerial censuses of big game and waterfowl to the use of marking devices for individual animals. While some techniques give accurate results most give estimates and some only "guesstimates" of the actual condition. Depending upon the degree of accuracy required, the time and manpower available, a system of fact collecting can be set up to produce the necessary information.

If an observation is worth recording, it is worth recording accurately and completely. All facts which might have some bearing upon the significance of the observation should be included. A deer which has been killed by dogs is certainly a significant observation. However, the record has even more value if such factors as the condition and age of the deer and the depth of snow are also noted. If there is a possibility of error, then this should also be recorded so that others can make an intelligent interpretation of one's notes. Is the number of animals observed recorded as an estimate or an actual count? Were duplications possible?

People form impressions from what they see, and frequently what they see or remember is not representative of what actually existed. Generally, hunters remember only the years when certain game species were unusually plentiful and they erroneously use these as a standard for comparison. Because they kept no records they forget that there were also years of scarcity. All too frequently we tend to remember and

emphasize the abnormal and lose sight of the average situation. We often hear of unusually large deer weights and large pheasant broods, but seldom do people note what the average condition was.

Although most of us have to depend upon a scattering of observations to gain an impression of game status, we can increase the value of these observations by recording them promptly and accurately.

The present level of management and utilization of the game resource in B.C., with a few exceptions, requires only the population trend and general level of abundance. The continued annual collection of facts for these purposes is one of the main functions of the field staff. The longer such records are kept the greater their value.

In summary, it can be stated that game management must be based on a continuous collection of facts from all sources.

Sampling Procedures

Counts of wild animals are always interesting but are subject to suspicion, especially when a few hundred are supposed to represent a population of several thousand. In arriving at valid conclusions aboot sex ratios, fawn counts, brood counts, survival percentages, etc., based on field counts, certain rules should be followed. One rule of thumb is to continue collection of data until the ratios sought do not alter with additional data. Usually this method oversamples but does help when the size of the population being sampled is unknown. Some prior knowledge is desirable in establishing sample size. Generally 10% of a population, if this comes to over 100, gives accuracy useful for management. In measuring characteristics of individuals such as weight, girth, width of tail feathers, etc., it is recommended that 30 or more individuals of each age and/or sex be recorded.

Samples provide only estimates which, depending upon sample size and accuracy, have upper and lower levels. The actual population level may fall anywhere between these upper and lower levels and thus we refer to the limits of accuracy as the mean or average figure plus or minus a statistically determined number.

The major problem of sampling wild populations is that of obtaining a random sample. The males and females of most species have different behaviour patterns and often frequent different habitat. Sampling of game populations must be done with a prior knowledge of the habits of the species under consideration or otherwise bias will result. Sampling is a most useful tool of management but bearing in mind the vast area of B.C., the widespread distribution of many species, and the various densities of animals encountered, it is apparent that, at best, we can sample only small populations or segments of larger ones. This need not deter one from applying these findings providing the sample areas are representative of the area at large.

In summary, counts of animals and measurements of individuals can be misleading and result in improper interpretation, but by applica-

tion of simple statistics the real worth of data can be evaluated and the proper conclusions drawn.

Aging and Sexing Game Animals and Birds

Depending upon the species, the age and sex composition of a game population determined either from field observations or game bag-checks provide useful clues regarding the status of the population and the effect of hunting and other factors upon it. Whenever possible, information as to sex and age of animals examined on road checks or in the field should be recorded. In most cases it is sufficient to classify individuals simply as "juvenile" or "adult".

There exist techniques for aging most wildlife species particularly our common big game animals, upland birds, and waterfowl. Likewise there are means of determining sex without dissection of game birds with similar male and female plumages either as juveniles or adults. These techniques while not perfect, are generally adequate for management purposes.

The effect of hunting on age classes - Before considering the techniques of age determination for certain big game species it would be well to explain some of the basic situations pertaining to hunted populations. From this the need for and the interpretation of age structure in the management of some species will be apparent.

The age composition of a big game herd provides a reliable and important indication of its condition. Hunting causes changes in the age composition of a herd if the harvest is sufficiently large. Male and females are born in about a 50 - 50 ratio. In unhunted herds mature males may be expected to comprise about 30% of the total population. Where herds are increasing a large proportion of the animals will be in the young age classes. In herds which are static or decreasing due to range conditions or other natural causes, a great proportion of the population will be made up of older age classes. Figure 2 is a hypothetical curve showing the age distribution in a herd of animals which is increasing.

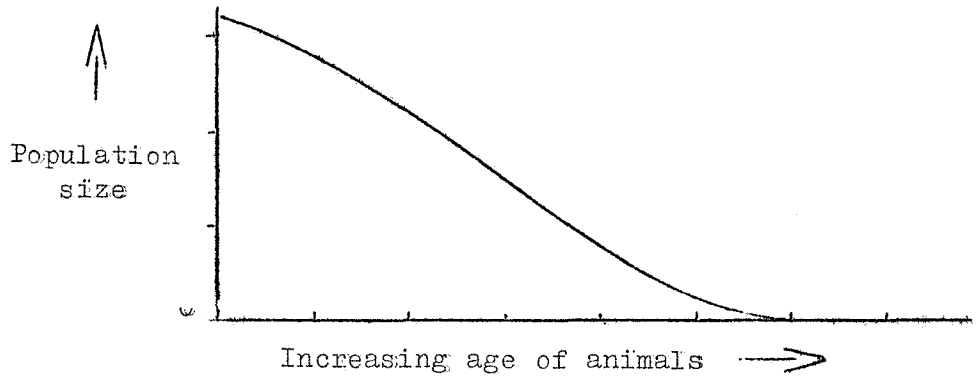


Figure 2 - Age structure of an increasing population.

Figure 3 is a hypothetical curve showing the age structure of a herd of animals that is decreasing due to natural causes.

Figure 3 – Age structure of a population that is decreasing due to natural causes.

In Fig. 3 the proportion of young animals is proportionately far less than in Fig. 2. In almost all cases population declines are due to a failure to reproduce or failure of young animals to reach maturity. Lack of feed, heavy parasitism, and excessive predation all affect the young more than the mature. Lack of feed and incidence of diseases and parasites affect the aged to a greater extent than the vigorous mature animals. Inclement weather affects the weak of all age classes whether they be juveniles or adults.

Heavily hunted populations will almost invariably have a high proportion of young animals, and Fig. 2 will most nearly represent the age structure of such a population. Hunting merely shortens the average age span of the animals. Where reproduction is successful the population is able to maintain itself at the capacity of the range. Where the sexes are hunted unequally, as in the case of most of our big game and members of the deer family in particular, the two sex groups must be treated as separate populations. The males should be managed so that the greatest possible yield is realized from them, and the females treated so that adequate mature stock is perpetuated for breeding purposes, and the annual increase is harvested for human consumption. It follows therefore that males may be far more intensely harvested than females in truly polygamous species. Only enough males need be maintained to assure adequate breeding stock.

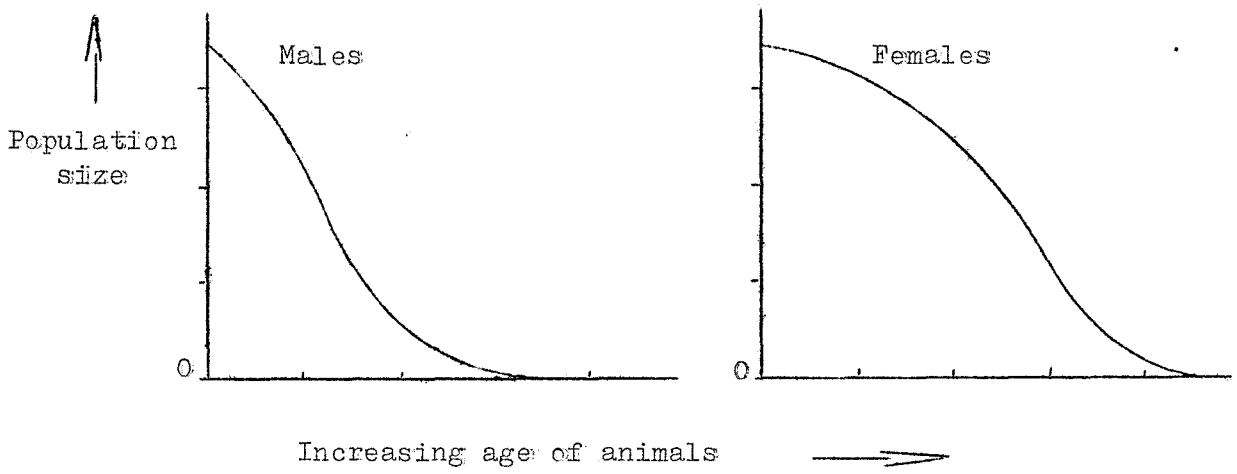


Figure 4 - Age structure in a moose population where males only are heavily hunted.

Figure 4 represents the hypothetical composition of bulls and cows in a heavily hunted moose population where bulls only are being heavily hunted. Here we see an equal annual increment of bulls and cows but the increased hunting pressure on bulls is manifest in the reduction of older age groups. Sufficient cows are retained to ensure perpetuation of the population and adequate bulls are retained for breeding purposes.

A population that is being heavily cropped and that is turning over rapidly will produce more animals than one that is lightly cropped. If we start out with a capacity population, and most B.C. game herds are at or near capacity, it is good management to turn over the population as rapidly as possible. It stands to reason that where the average age of bulls is 2 years the average forage debit per animal is half that where the average age is 4 years. Hence better use is being made of the forage. The same principle holds true for cows, but further consideration here must be taken into account for the reproductive role. Once a cow has raised another cow to maturity (breeding age) she is herself surplus and subject to cropping, for her offspring now takes her place as the reproductive unit in the herd.

Under ideal conditions, such as pertain in strictly managed areas in Europe, only old females would be taken deliberately. Under our system of free hunting the crop must be controlled on an over-all basis. While we can never reach the limits of production possible under

the stricter types of management we can increase the efficiency of harvest considerably. It follows therefore, that there must be a continuous flow of accurate information upon which to judge the effects of hunting and other factors that are affecting our big game populations.

Aging Techniques - Big Game Animals

Animals may be aged with varying degrees of accuracy by changes in form that occur due to growth or wear of various organs. Teeth and horns provide fairly accurate criteria of age.

Horns - The only 2 horned big game animals in B.C. are sheep and goat. Horns are permanent appendages and grow throughout life. Each year during the winter the growth rate slows down resulting in a "growth check" in the form of a ring around the horn. The horns of males exhibit these checks most clearly.

In male bighorn sheep winter checks are very pronounced and with little practice the aging of bighorn rams becomes easy and accurate. Ewes show a large increment each year until they produce lambs, then annual growth of the horns becomes very much reduced and accurate aging becomes difficult due to the possibility of confusing annular rings with the other ridges on the horns.

Goats exhibit similar growth rings to sheep. Billies are relatively easy to age up to senility when the annual rings become so close together that they are hard to define accurately. Nannies are similar to sheep in that after they produce kids the annual increment slows down and growth rings are difficult to distinguish. Nannies average longer horns and more recurved horns than do the billies.

Horn is actually modified hair, that is, it is derived from the same germinal layer as hair and has a similar chemical composition. (Burn hair and horn and the resulting "aroma" is very similar.) In young goats the early horn growth is fibrous in nature forming a fibrous sheath over the hard inner core. This fibrous covering is polished off in time and the first winter check is frequently polished out and barely distinguishable.

Teeth - All our ungulate game have similar tooth patterns with minor variations between species. Adults carry 4 incisors (3 true incisors and 1 incisiform canine), 3 premolars, and 3 molars in each lower jaw (or mandible) and 3 premolars and 3 molars in each upper jaw. Elk and caribou also carry 1 canine tooth in each upper jaw (maxilla). The canine tooth of elk is large and used as a lodge emblem by the Elk Lodge. Caribou canines are small and are set in large pits (alveoli). They barely project through the gums.

The age of animals is obtained by tooth succession and wear on the grinding teeth of the lower jaw or mandible. The mandible is easily detached from the skull and when incisors and grinding teeth are both left intact it becomes more suitable for study purposes. Evolutionists have good evidence to indicate that the 1st premolar of deer has

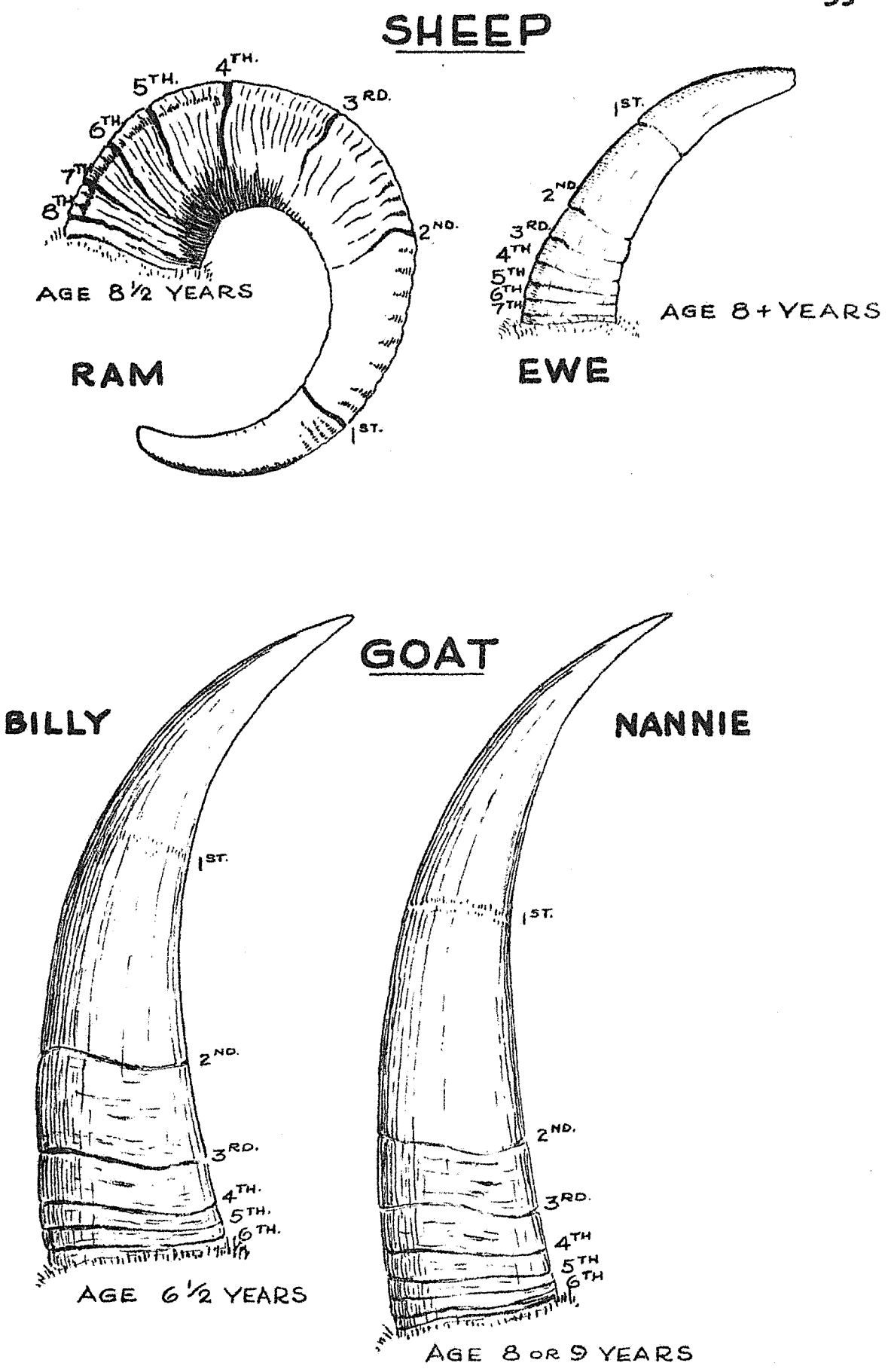


FIGURE 5. AGING BY HORN GROWTH

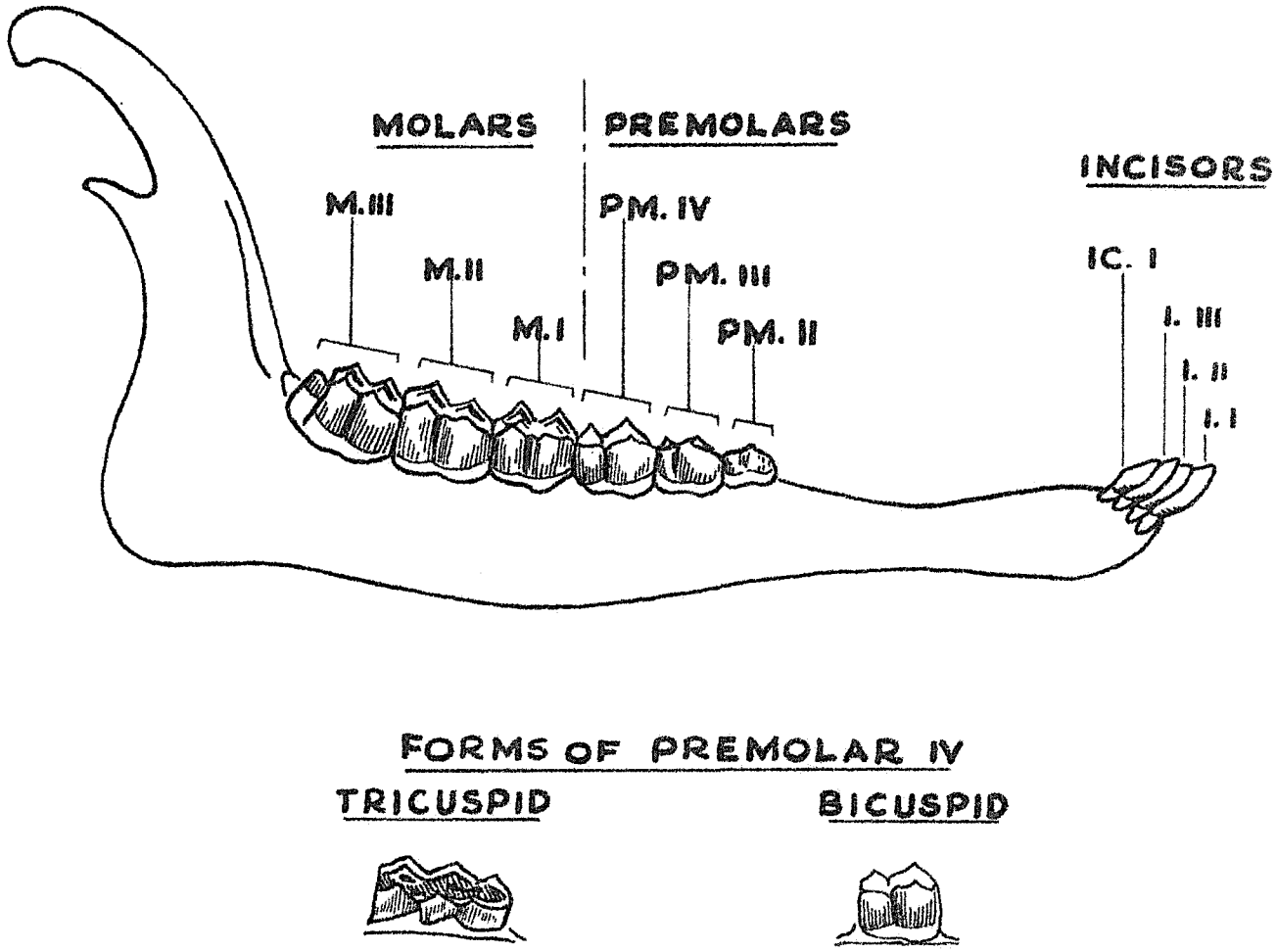


FIGURE 6. DENTITION IN DEER.

degenerated and disappeared hence the remaining 1st premolar is designated.

The accompanying charts show the time of tooth succession for each particular species. All these animals have milk or deciduous incisors and premolars. These are shed and replaced by permanent teeth. Deciduous or milk teeth are easily distinguished from permanent teeth by their form. The deciduous incisors are narrower and more tusk-like in form than the permanent incisors. Permanent incisors also have a definite blade or spoon-shaped tip to them until they become broken or worn. Deciduous premolars are much smaller than the permanent premolars and differ somewhat in structure. P.M. IV (premolar) is most distinctive in that in its deciduous form it is tricuspid (that is, it has 3 distinct cusps or columns). The permanent P.M. IV has only 2 cusps or columns, hence it is a bicuspid (see Fig. 6). This marked change in structure renders the P.M. IV the most important tooth for a quick check of an animal's age. Any deer carrying a tricuspid P.M. IV in hunting season is a long yearling, that is, 18 months. While any deer carrying a bicuspid P.M. IV is at least 2 1/2 hears old. Moose on the other hand, acquire their complete permanent dentition by the time they are 18 to 20 months of age, so many long yearlings taken in the hunting season are in the process of erupting permanent P.M.'s and losing their deciduous ones.

After an animal has acquired its permanent dentition, age may be judged by the amount of wear the teeth exhibit. Very long and rather involved descriptions are needed to describe adequately the wear classes in each instance.

The following charts indicate the period at which each species of the deer family undergo the transition from deciduous to permanent dentition. Reading from left to right the first number indicates the age in months at which replacement commences and the last figure the age in months at which the replacement is completed. The age in months is also indicated along the top of each table for further reference. It is assumed that all the young are born in June. While this is not entirely accurate those born early will constitute the early classes and those born late the later classes represented by the charts. On the average, the majority of the species will have completed the development of their teeth about 2/3 of the way through the period as indicated by the chart, and the chart should cover 95% of the cases examined.

For the sake of convenience a conversion chart has been supplied for ready reference in converting age in months to the months of the year. For example: In what month will a 16 month-old animal be found? Look up 16 and the month will head the column, in this case October. Another example would be: In what months do moose replace their premolars? The tooth succession chart indicates during the 14th to 18th months. Reference to the conversion chart will immediately show you that these are the months of August, September, October, November, and December. The greatest number of replacements will be during the months of September, October, and November.

Conversion chart of age and months.

Month --	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
1st year	Born	1	2	3	4	5	6	7	8	9	10	11
2nd year	12	13	14	15	16	17	18	19	20	21	22	23
3rd year	24	25	26	27	28	29	30	31	32	33	34	35
	36											

Tooth succession in British Columbia cervids

Mule Deer

Age in months	4	6	9	12	18	22	26	30	34	36
Incisors 1			10.....16							
Incisors 11			10.....16							
Incisors 111			10.....16							
Incisors 1c 1			10.....16							
Premolars 11						22....25				
Premolars 111						22....25				
Premolars 1V						22....25				
Molars 1		5....10								
Molars 11			7.....14							
Molars 111				13.....24						

White-tailed Deer

Incisors 1			7.....15							
Incisors 11			8.....15							
Incisors 111			10.....15							
Incisors 1c 1			10.....15							
Premolars 11						20.....25				
Premolars 111						20.....25				
Premolars 1V						20.....25				
Molars 1		6.....14								
Molars 11			9.....16							
Molars 111				12.....24						

Moose

Incisors 1			9.....14							
Incisors 11			10.....15							
Incisors 111			11.....16							
Incisors 1c 1				14.....20						
Premolars 11				14.....18						
Premolars 111				14.....18						
Premolars 1V				14.....18						
Molars 1		6...10								
Molars 11			8.....15							
Molars 111				14.....18						

Continued --

Tooth succession for British Columbia cervids (cont'd)

Elk

Age in months	4	6	9	12	18	22	26	30	34	36
Incisors I				14.....23						
II				16.....24						
III					19.....28					
Ic I					19.....29					
Premolars II							27.....32			
III							27.....32			
IV							27.....32			
Molars I	5.....16									
II			13.....21							
III					20.....29					

Caribou*

Incisors	I	?.....16		
	II	?.....16		
	III	?.....16		
	Ic I	?.....16	Complete at 16 months	
Premolars	II	14.....18		
	III	14.....18		
	IV	14.....18		
Molars	I	3.....16		
	II	12.....18		
	III	14.....21		

* Note – The data for Caribou was taken from a publication on Barren Ground Caribou. These animals may differ somewhat from the Mountain Caribou with respect to the times of tooth succession but it is doubtful that the difference would be sufficient to cause much overlap in the times of tooth replacement.

Aging and Sexing Techniques - Game Birds

Much of the data on sex ratio and age distribution of game bird populations is gathered during the fall and winter hunting seasons at which time plumage and development of some species has not reached a stage which permits positive classification by superficial examination. For many species however, there are certain features or criteria which make possible a fairly reliable determination of the sex and age of individuals.

Age classification of game birds is generally limited to differentiation between juveniles, yearlings, and adults. More often (depending on the species involved) the division is confined only to juveniles (young-of-the-year) and adults. When a bird has passed the point of maturity by any length of time it is practically impossible to determine its actual age in years by internal or external appearance or condition.

The methods known and used for aging and sexing are primarily field techniques and while usually reasonably satisfactory are not completely infallible. Care must be used when applying certain techniques to certain species, as there are variations between related groups with respect to rate of growth and maturity. It is also possible to have regional differences between the development in individuals of similar species due to such environmental factors as food, water, climate, etc. And then, of course, there is always the odd individual which falls to one side or the other of the "normal" thus causing some doubt and confusion to the person making the classification. In such cases it is best, where possible, to use different methods of determination and accept the indication which seems best substantiated.

Before considering specific techniques for particular species it should be explained that there are one or two anatomical features pertaining to sex and age development common to virtually all game birds.

1. Sex determination by gonadal examination - When the sexes of a species cannot be distinguished by external features reliable differentiation may be made by dissecting for an examination of the gonads or reproductive structures. Males may be identified by the presence of the testes which are situated almost side by side, one on the forward end of each kidney. Size of the testes will vary with age and according to the breeding activity of the bird. The testes become enlarged during the breeding season and may appear as creamy, bean-shaped structures.

Females may be recognized by the presence of the ovary located on the forward end of the left kidney. As a rule most birds do not possess a right ovary. The ovary appears as a grape-like cluster of small spheres of varying size which develop in size during the breeding season and attain the familiar yellow color of yolk material.

2. Aging by the Bursa of Fabricius - The Bursa of Fabricius is a sac-like structure which develops during the embryological stage in the life of both waterfowl and upland game birds. It is situated as an apendage to, and above, the large intestine and opens into the cloaca

above the rectal opening.

Following hatching and throughout the period of juvenile growth the bursa is gradually resorbed until, at maturity, the opening into the cloaca no longer exists and has disappeared. The length of time required for this process varies with the species but in most is accomplished in less than one year. Thus, it is possible to classify those birds in which the bursa is absent as "adults," and those in which it is present as juveniles or yearlings, depending on the degree of resorbtion.

The following are <u>approximate limits</u> of the period in which the bursa may be present and usable as a means of aging some species:

Ducks - All dabblers, Canvasback, Redhead, Ring-necked, Scaups, and Ruddy duck - Late December of first winter, sometimes present in some individuals in April or May.

Geese (and some diving ducks) - Over one year of age.

Willow grouse - March or April following first winter.

Blue grouse - At 3 to 4 years.

Pheasant - Late December of first winter.

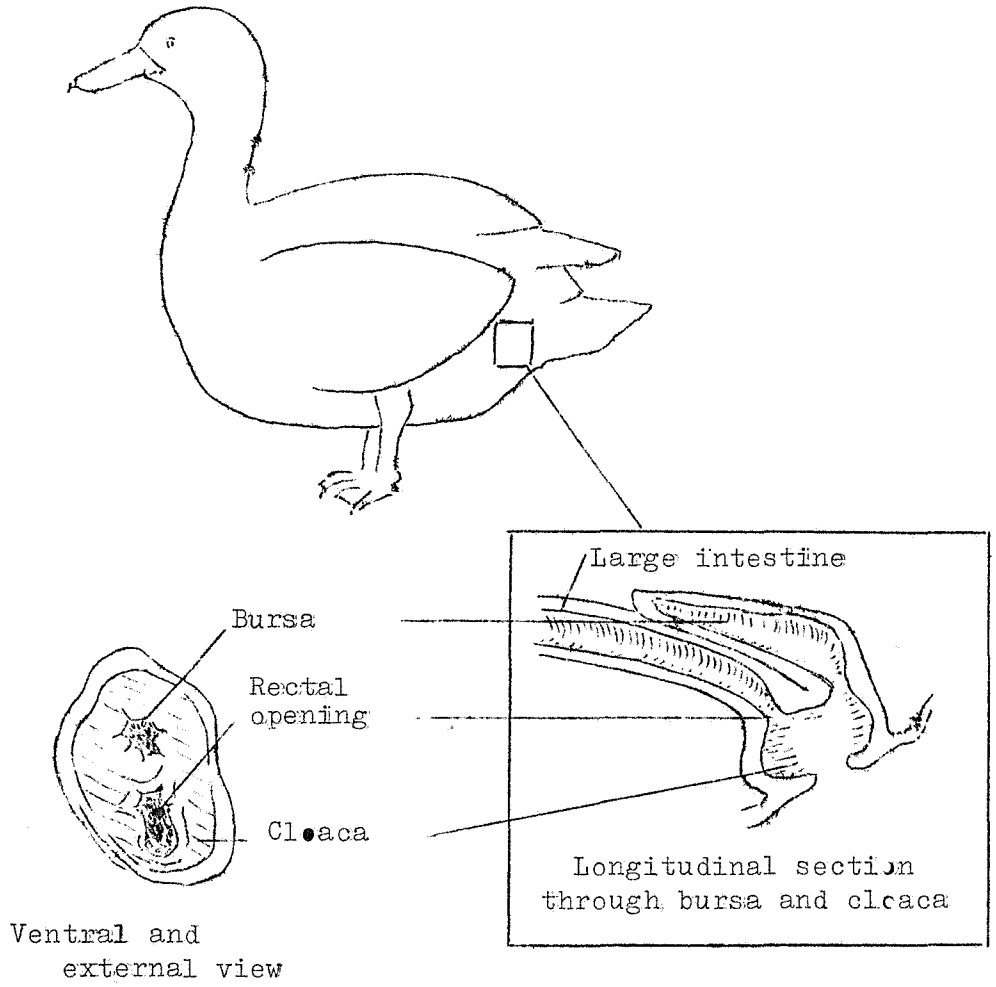


Figure 7 - The Bursa of Fabricius.

The more specific techniques which follow are those most generally used for the species concerned. There are often many other criteria which serve to differentiate between age and sex but they will not be considered here.

Waterfowl

Sexing - (1) Males in the waterfowl group may be distinguished by the presence of a penis located in the forewall of the cloaca.

(2) Among the ducks, except for some diving ducks such as canvasbacks and scaup, any evidence of vermiculations or fine, wavey, grey and black barring on the feathers of the flanks or back of any adult or juvenile bird in autumn moult, is indicative of a male.

Aging - (1) Juvenile males possess a small, white penis, pig-tail like in shape. Adult males have a much larger, white or greyish penis encased in a conspicuous sheath. In adult females the opening of the oviduct appears as a slit in the left wall of the cloaca. In juvenile females the oviduct is still closed off by a membrane and is not apparent.

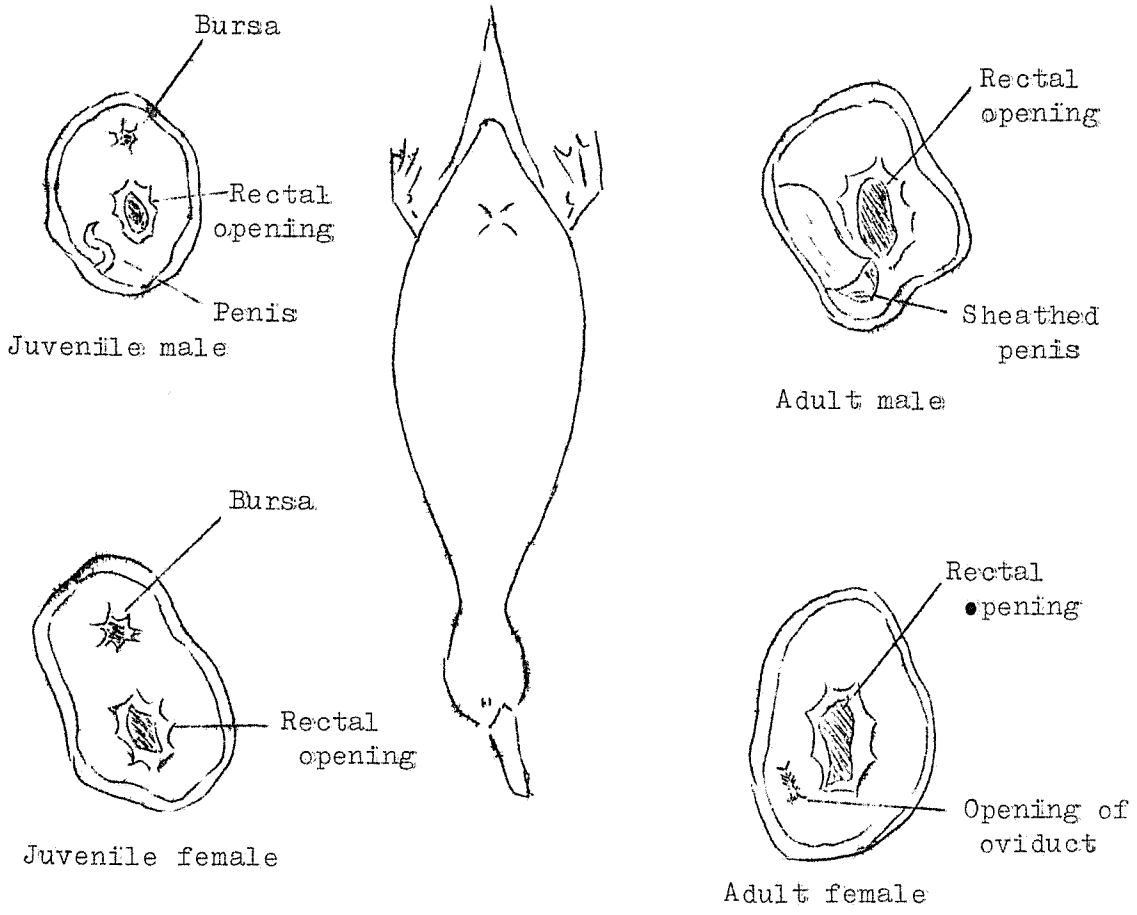


Figure 8 - Aging and sexing waterfowl by cloacal examination. (After Kortright).

(2) In the waterfowl group any bird having tail feathers with "notched" or square tipped ends is a juvenile.

But - Any bird having a tail feather normally rounded or pointed with no "notch" visible, may be an adult -- or a juvenile which has completed its moult into first winter plumage.

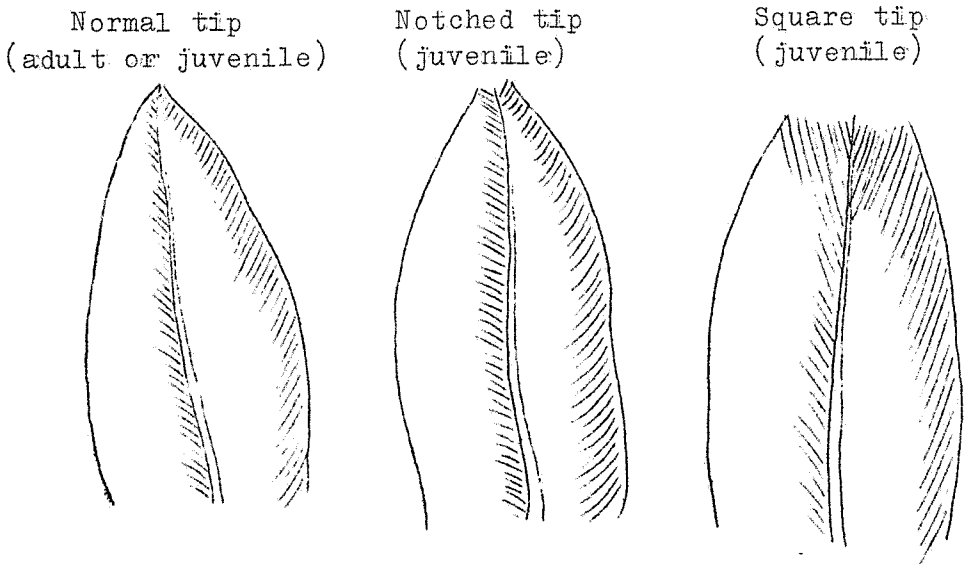


Figure 9 - Aging waterfowl by tail feathers.

Upland Birds - General Techniques

The males of the gallinaceous (or Upland) game birds, in contrast to the males of the waterfowl group, show no conspicuous evidence of a penis, except during the breeding season in some species.

Aging - Apart from the bursa there are two other techniques used to determine age of upland birds generally, during the fall and winter harvest period.

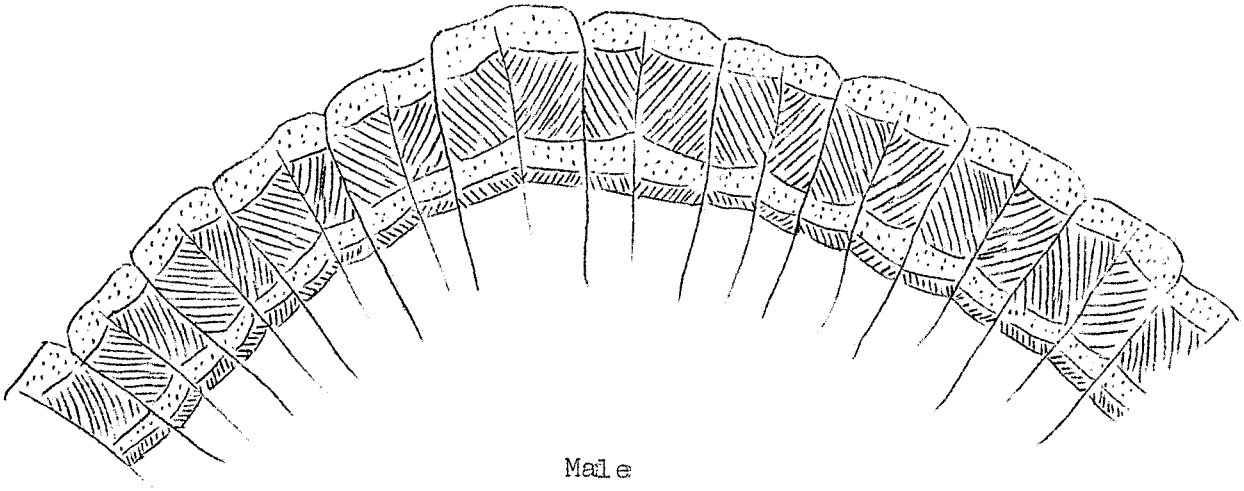
(1) Ossification of the mandible - Complete ossification or hardening of the bone structure in gallinaceous birds is not usually achieved until after the first winter. If a bird is held suspended by the lower jaw so that its entire weight is borne by this structure, the jaw will bend sharply or break if the bird is a juvenile. If the bird is adult the jaw will support the weight without any evidence of bending.

(2) Ossification of the sternum - The breastbone, often called "keel", or sternum, in young birds of the year is partly cartilagenous, rubbery, and soft, as compared to the hard, fully formed structure in most adult birds. Palpating the sternum may serve to age the bird as juvenile or adult.

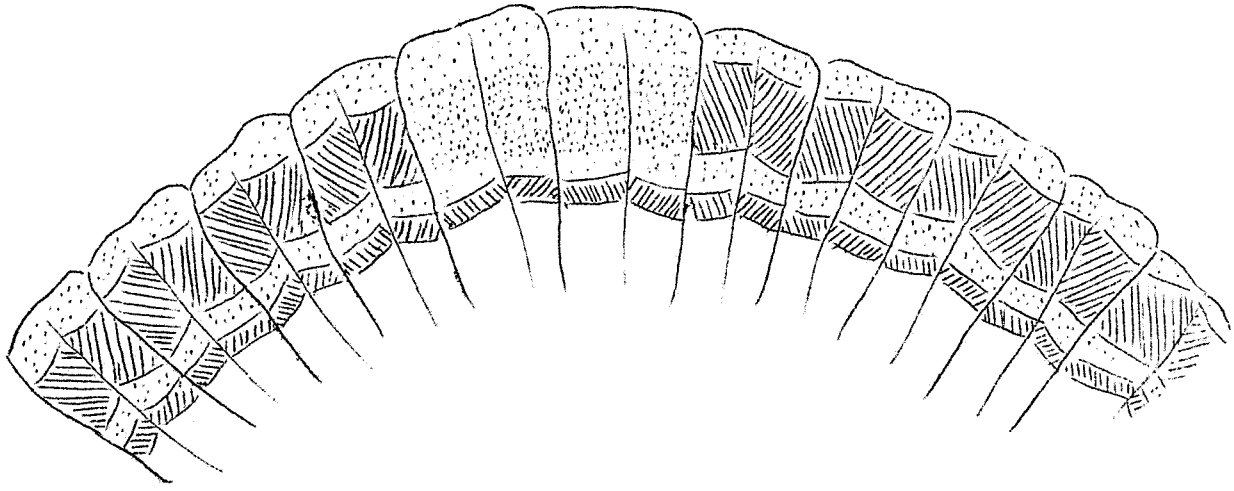
Upland Birds - Specific Techniques

Willow grouse

Sexing - By tail feathers - Where broad, dark, subterminal band on the spread of the fail feathers is uniform and unbroken the bird is almost always a cock. But -- if the subterminal band is broken on the two middle feathers the bird may be either male or female. In this situation the length of the tail, according to some authorities, may be indicative of sex, with tails of $6\frac{1}{4}$" or over being classed as males and those of 5 3/4" or under as females. This should be verified for local use.



Male



Female

Figure 10 - Sexing ruffed grouse by tail feathers.

Aging - By wing primaries - The two outer wing feathers or primaries on each wing of young or juvenile grouse tend to be noticeably sharp-pointed at the outer tips as compared to the rounded tips in the adult birds.

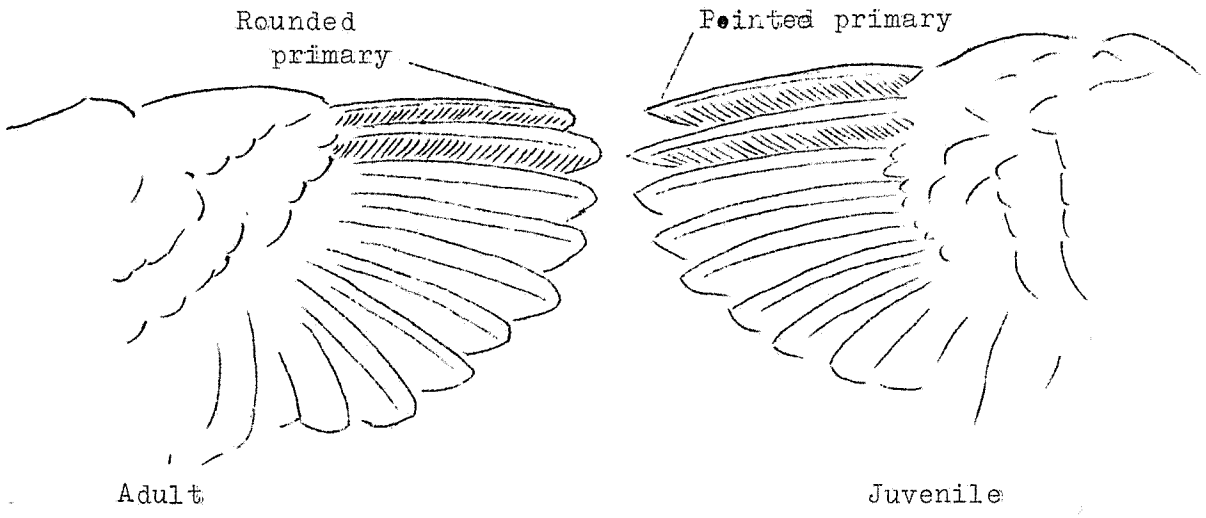


Figure 11 - Aging ruffed grouse by wing primaries.

Blue Grouse

Sexing - Adult birds present no difficulties but young-of-the-year may provide some problems. Young males may be identified by the "hooting patch," an area of bare, smooth skin surrounded by a basal ring of white feathers on each side of the neck. The appearance of dark blackish feathering on top and sides of the head is found on young males.

Aging - (1) Bursa of Fabricius - Studies of the Sooty Grouse on Vancouver Island indicate the complete resorbtion of the bursa in Blue Grouse to require a much longer time than is the case for many other gallinaceous birds. As a result care must be used in establishing age by this method. Studies of Blue Grouse on Vancouver Island by Dr. J. Bendell found the bursa in yearling grouse to range from about 1/16" to 1/2" in depth but was most often about 1/4" deep. Adult birds of 2 to 3 years of age were found in many instances with some evidence of the bursa still present, particularly in males. Complete disappearance of the bursa was believed to be typical of birds of 4 years or older.

(2) Length of tail feathers - Yearling birds (grouse between their first and second falls) were found to have the outer pair of tail feathers ranging between 5 3/16" and 6" in males,

and between 4 3/8" and 5 1/4" in females. In adults (birds between their second and later falls) these measurements ranged between 6 3/8" and 7 5/8" in males and probably between 5 3/8" and 6 3/8" in females.

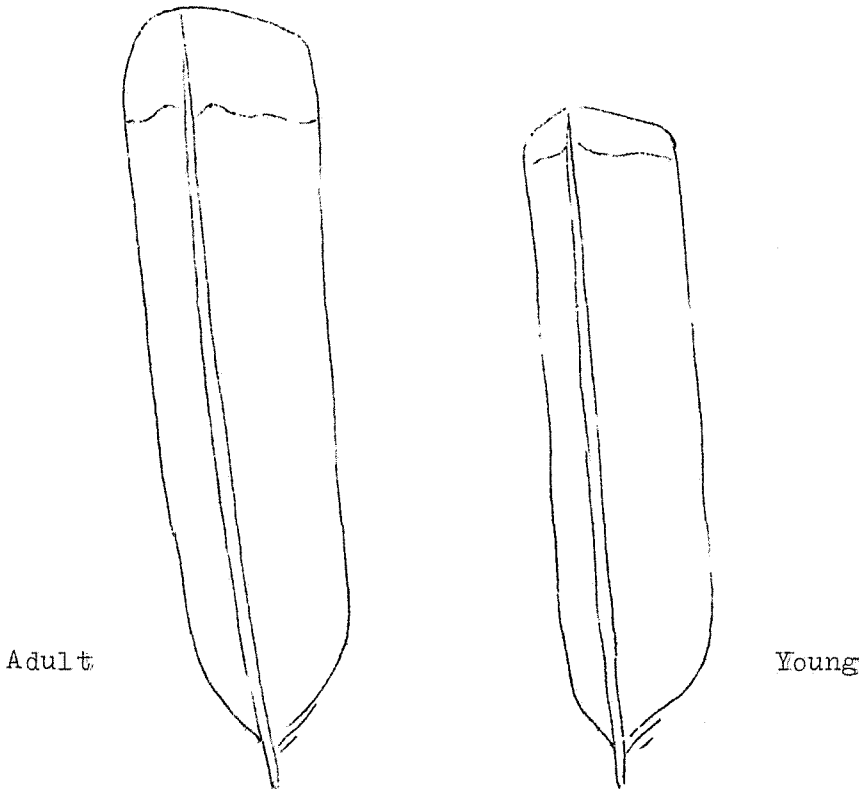


Figure 12 - Comparative size of tail feathers in adult and young blue grouse.

Sharp-tailed Grouse

Sexing - This may be determined by the appearance of markings on the tail feathers. Markings which run across the width of the feather indicate a female and those which run along the length of the feather indicate a male bird.

Aging - No data available. Use general techniques.

Franklin Grouse

Little specific information is available for aging and sexing of this group. It is probable that some of the general techniques may be applicable.

Pheasant

Aging - Spur development - A widely used method of aging cock birds is by means of a "Kimball gauge." This is merely a 3/4" hole drilled in a flat piece of wood into which the leg of the bird may be placed. If the spur and leg combined can pass through the 3/4" hole the bird is a juvenile; if it can not, it is an adult.

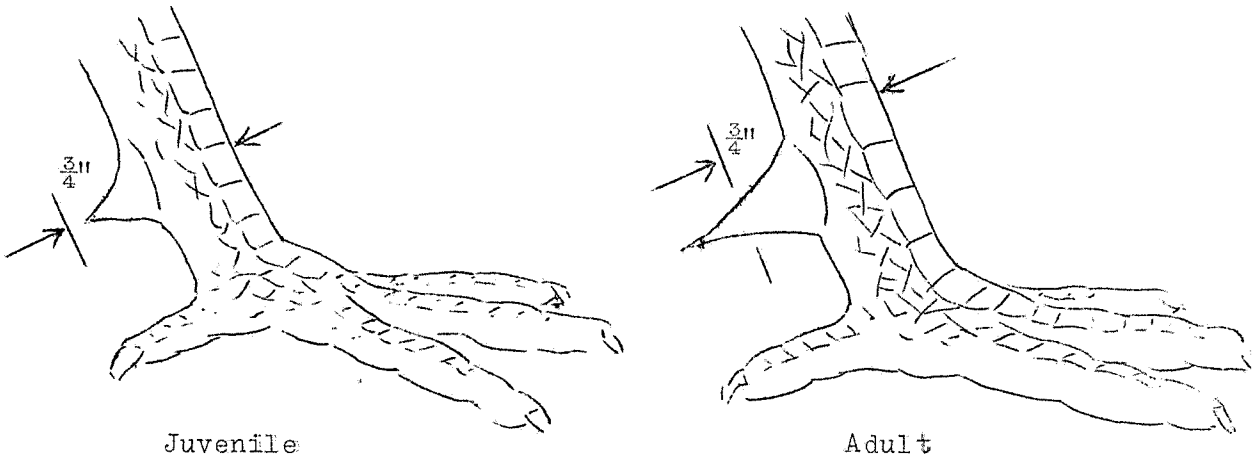


Figure 13 - Aging cock pheasants by spur development.

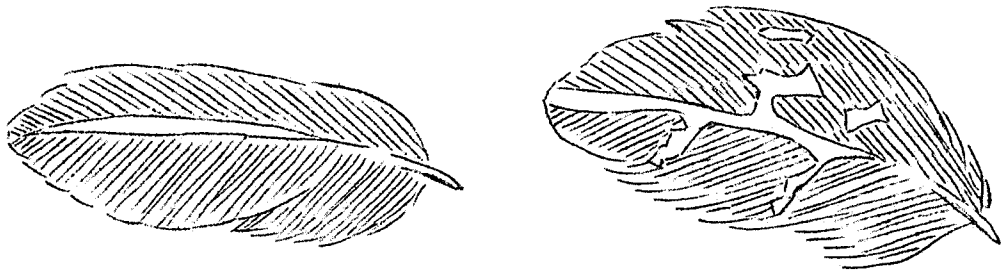
Chukar Partridge

Sexing - No reliable method other than dissecting for examination of gonads.

Aging - According to Oregon publications, juveniles have a black bill and adults have an orange bill.

Hungarian Partridge

Sexing - Males may usually be identified as having coverts with a single light stripe running lengthways along each feather. Females have similar markings and in addition have a light cross-bar present on each feather.



Male Female

Figure 14 - Sexing Hungarian partridge by wing covert feathers.

Aging - Oregon reports adults can be differentiated by their bluish-grey feet, whereas the juveniles have yellowish-brown feet.

California Quail (data from Oregon publication)

Sexing - Birds with black throat and long plume on head are males. Those with grey throat and short plume are females.

Aging - Young birds have white line and dot on primary coverts. Adults have a plain, grey primary covert.

Inventory of Game Populations (Census)

Census of a game population is seldom absolutely accurate but it can be designed at least to give population trends and a good idea of population size. The two most widely used census methods in B.C. are aerial counts and hunter kill figures. In addition to these there are other census techniques available to the game manager to determine the number and density of game animals and birds. Nearly all are based on sampling techniques of one type or another and are used mainly to gather management information. Other measuring techniques such as area counts, tagging and recaptures, etc., are used principally for detailed work of a research nature. An annual system of measuring the kill over large areas (hunter sample) together with facts derived from intimate knowledge of smaller areas (road checks, aerial census, and field study) provide the best basis for management.

The following lists and brief descriptions present a few of the more common census methods as applied generally as well as in the case of particular types of game.

Direct methods of census

1. Aerial counts - Big game sampling counts from aircraft. Used principally on moose in the Cariboo and deer and elk in the Kootenay.

2. Road side counts - A tally of deer, other big game, and game birds may be made from a car and repeated in the same area each year at the same time (e.g., ruffed grouse drumming counts).

3. Winter range counts - A tally of deer and other big game made on the winter range.

4. Migration counts - Records of black brant numbers and other migratory birds at established points each year during the migration period.

5. Transect counts - These are sample counts made while travelling an established route through game habitat at selected times of the year.

6. Composition counts - A sample count of the sex and, where possible, the age classes in a population of game animals or birds. Used on pheasants and coast deer principally, also on moose in the Cariboo area before males lose their antlers.

Indirect methods of census

1. Pellet plot counts - A count is made of animal or bird droppings on established sample plots throughput the area inhabited by the animal or bird. This method can be used to provide quantitative or relative trends from year to year.

2. Tagging and recaptures - By comparing the rate of return of tags and bands the effect of hunting pressure may be estimated. Used mainly on ducks.

3. Hunter sample - The annual statistical estimate of game killed by hunters. Based on analysis of mailed questionnaires returned from a random sample of firearms licence holders.

4. Total harvest off small areas - A complete record is kept of the kill on a known area (e.g. moose in Wells Gray Park).

5. Composition counts - (See above). Age and/or sex ratios obtained by direct sampling may be used indirectly to census or appraise a particular population.

Upland bird census techniques

1. Counts of males during breeding season - Drumming, hooting, or crowing males are recorded at the height of the breeding season at established points throughout the breeding grounds. Trends in population density may be indicated regionally or annually.

2. Flushing counts on sample plots - Birds are flushed and numbers recorded for a known area.

3. Brood counts - Brood size is recorded throughout the summer months at periodic intervals. This provides an indication of reproductive success and hence the probable quality of hunting that may be expected.

4. Total counts on breeding grounds - A count is made of such species as sharp-tail grouse and sage hens on their restricted breeding area to determine the relative status of the breeding population.

Waterfowl census techniques

1. Aerial survey of breeding or winter populations - Total or sample counts are made of breeding pairs and wintering concentrations.

2. Transect routes - Breeding and brood counts are made from road transects, aircraft, and on foot. Usually only a sampling technique.

Fur-bearer census

1. House counts of beaver, muskrats - An annual inventory of beaver houses and muskrat push-ups.

2. Trapping returns - Trends of population by comparing catch from year to year for equivalent effort.

3. Tagging and recaptures - Population size is determined by use of a simple equation involving ratio of tagged to untagged animals in the catch.

Census methods are most useful when a series of yearly comparisons are available. By following the same procedure each year one arrives at a safe basis for determining population trends.

Measurement of Browse and Plant Composition (Range Surveys)

Most game species live in a changing environment. The plant composition and food supply of the habitat is seldom static but changes over the years. Moose, deer, elk, willow grouse, and coastal blue grouse, are generally most plentiful where the vegetation is in relatively early stages of regrowth after logging, clearing or burning. As the

vegetation determines the existence and abundance of the different species it is of value to know how the plant cover is changing. Usually the trend is from grasses and forbs through shrubs and woody plants to trees. Most often the changes are obvious as on Vancouver Island but they can be obscure and take many years, especially in low rainfall areas such as the East Kootenay and parts of the southern interior. Range surveys measure these natural changes and, of equal importance, they measure the influence of the animals upon the plants. The relationship between plants and herbivores is of vital importance for the food plants control the animals which in turn determine the condition and vigour of the preferred or key browse species.

The following techniques are used to determine the plant composition and the effect of browsing:

1. Plant composition - Measurement of trees, shrubs, and ground cover. One may determine the numbers or importance of each species in a randomly selected plot or by the amount of ground covered by each species. Plots are usually 1/1,000 acre for grasses, up to 1/10 acre for shrubs, and from 1 - 10 acres for trees. Other techniques employed are the line intercept and the point intercept methods. These give the plant composition along the total length of randomly selected transect lines and at regular points along such lines. They are most applicable to grassland or ranges interspersed with shrubs.

2. Measuring the degree of use or intensity of browsing

a. Exclosure plots - These allow certain animals entrance and exclude others or they may exclude all grazing species.

b. Ocular estimates - Amount of browsing on shrubs is estimated visually and reported on a standard form.

c. Clipping and weighing - Twigs are marked and measured before and after the browsing period to determine the amount of food consumed. By weighing twigs of important browse species before and after browsing estimates can be made not only of the potential forage but also of the percentage removal or use during the winter.

The use of indicator species on key winter ranges to determine the utilization has value on those ranges which change slowly. The technique has less application however, on the dynamic seral ranges of Vancouver Island and the coastal forest. To be of greatest value, permanent plots or transect lines should be established and surveyed on an annual or biannual basis.

Game Checking Stations

The value of road checks whether spot checks or established checking stations cannot be over-emphasized. They have two main benefits apart from law enforcement. First, they supply information on hunter success which can be checked against previous years' and the hunter sample data; and second, they furnish the opportunity for field per-

sonnel to check the animals which are being harvested. Age of animals in the harvest, weight and condition, etc., can be ascertained. This type of information is necessary in order that the generalities obtained from the hunter sample and other sampling methods (aerial survey, range surveys) can be better interpreted. All hunters, successful or otherwise, must be recorded if annual comparisons are to be made. Road checks provide detailed information from local game populations.

Hunter Sample or Postal Survey

The progress of a game management program is best evaluated or measured by the harvest of animals on a sustained basis. There are various methods used to determine kill figures. These range from compulsory hunter returns to the immediate reporting of each animal taken. In B.C. a post-season questionnaire survey is used. It is not set up to give absolute returns, but rather to show harvest trends. Accuracy in determining the annual harvest varies from 7% either way for the deer kill on Vancouver Island to as high as 20% in respect to other big game species where the sample is not as large. The calculated kill has been checked for Vancouver Island and close agreement shown between the two independently determined totals. The method is most applicable to species of game sought by a large number of hunters such as deer, grouse, ducks, moose, and pheasants. Although the kill figures obtained fall between defined upper and lower limits they serve as an important method of measuring trends in game utilization. The value of the Hunter Sample can not be overstressed and at every opportunity personnel should encourage individuals who are sampled to return the questionnaire. Here is just one example of how good publicity can serve game management.

Predator Control Techniques

The purpose of predator control is to restrict the activities of the various predator species to a point where they are no longer of physical or economic concern to man's interests. This does not imply complete extermination of a predator group as is often thoughtlessly advocated. Control techniques are generally many and varied but in British Columbia the following methods are used:

1. Poisons

a. Compound 1080 - This compound was originally introduced as a rodenticide but is now widely known as a control agent for members of the dog family in particular but is extremely suitable for bear or any other large predator. This compound (technically known as sodium fluoracetate) comes in powdered form and is dissolved in warm water. It is then ready to inject into the meat that is being used for bait. Its chief advantage is that it is supposed to be tasteless and odorless. It should be handled with extreme caution.

b. Cyanide guns - Usually known as coyote getters. These "gadgets" are extremely useful for the control of predators over a small area. They are capable of killing large animals (350 pound grizzly). The cyanide gun is simply a tube which is driven into the ground, a de-

tonating mechanism, and a shell holder which holds a .38 calibre shell loaded with cyanide. Cotton batting or sheep's wool is wrapped around the shell holder and impregnated with a suitable scent. The gun is then ready for operation and can be placed anywhere. This weapon can be safely used quite close to habitation only if proper caution is used.

c. Strychnine or wolfbane - This substance was once used in great quantities but is now only used in rare cases. Its chief disadvantage is that it does not break down and disintegrate as 1080 does. This means that any strychnine bait on land must be picked up and destroyed because strychnine will not disappear readily.

2. Dogs - Trained dogs are used mainly as a measure to destroy and control cougars. There is as yet no other effective way to control this species. Dogs can also be used for bear with fair success. The cougar or bear dogs must be well-trained as reliable hounds that the hunter can trust improve the chances for success.

3. Traps and snares - These are used mainly for complaint work or within heavily settled areas such as the Fraser Valley and are particularly valuable for this type of control. Successful trapping requires training, skill, and knowledge beyond that generally realized. One disadvantage of trapping is the limitation in the number of traps that can be looked after adequately.

Laboratory Studies

At present there are many studies underway at wildlife research centres across North America. Techniques for determining obscure but important aspects of game and bird biology are being developed. Blood chemistry, nutrition levels necessary for health, and animal behaviour studies, are supplying new ideas to assist the game manager in his interpretation of facts gathered in the field.

Biological Aids to Law Enforcement

Biological evidence can serve as an aid to law enforcement by supplying supporting facts to be used with the regular evidence. Cases under the "Game Act" may, at times, hinge on the identification of specimens or fragments of the same. The following are methods of use to enforcement:

1. Precipitin reaction - This involves identification of animals through testing blood or blood stains. It is based on the fact that when a foreign protein enters the blood system of a living animal, the recipient builds up antibodies in reaction to the foreign material. Blood serum from an immunized animal in contact with the same foreign protein in a test tube forms a visible precipitate. Only in important cases should this assistance be called for as the technique can only be applied at properly equipped laboratories such as that operated by the R.C.M.P. in Regina, Sask.

2. Examination of hair samples - Specimens of hair may be identified when checked against known examples. Texture, shape, and cell arrangement of hairs differ from one species to another.

3. Aging and sexing criteria are of value whenever the hunting regulations differentiate between the sexes and among ages of animals.

4. Skeletal remains can be identified. For example pheasant and grouse bones differ from those of chicken in form and size. Likewise the bones of big game animals differ between the species and from those of domestic animals.

5. Molt patterns and other physiological changes may be used to indicate the time when a given specimen was taken.

Collecting and Handling Material for Examination

1. Parasites and pathological material - Diseased tissue may be shipped frozen if conditions are such that it will remain frozen in transit. Freezing is the best method if this is possible. If not, the following method will suffice: Make up a solution in the following manner of at least 5 times the volume of the object to be preserved: 6 parts formaldehyde, 15 parts of 95% ethyl alcohol, 1 part glacial acetic acid, and 30 parts water. Keep the material in the solution for a week then pour off the liquor and wrap the specimen in absorbent material prior to shipping. This preservative will not penetrate more than one-half inch into a block of material so cuts must be made at one inch intervals if a large mass is to be preserved.

In most cases diseased material will reach the laboratory in good condition without the use of preservative if the weather is cool and it is frozen before shipping. Specimens should be sent to the nearest game biologist or to the main office. The consignee should be advised by wire of the time of arrival in instances where there is danger of spoilage. Use air express whenever possible when long distances are involved.

Freezing the complete carcass is the best method but in the case of the larger game animals such as moose, elk, and deer, this is not practical. An autopsy to detach the diseased portion is the best procedure. This portion can then be treated by freezing or by placing in the preservative.

GAME ANIMALS AND BIRDS OF BRITISH COLUMBIA

This section will emphasize the management problems and practices peculiar to each of the major game species in British Columbia. For details of description, taxonomy, distribution and the biology of upland game birds and big game species in British Columbia, the reader is referred to two Provincial Museum publications: Handbook No. 10, "The Birds of British Columbia (4): Upland Game Birds" by C. J. Guiguet; and Handbook No. 11, "The Mammals of British Columbia" by I. McT. Cowan and C. J. Guiguet. Similar information on the various waterfowl species is available in "The Ducks, Geese and Swans of North America" by F. H. Kortright. Anyone engaged in any phase of wildlife work in British Columbia should not be without these excellent references.

Throughout this section it is assumed that the reader has covered all that goes before it.

Breeding Characteristics of the Hoofed Game Animals of British Columbia

Species	Minimum breeding age of male	Age of female when first young born	Gestation period
Moose	2½ years ?	3 years	240 - 250 days.
Elk	2½ years	3 years, rarely 2	249 - 262 days
Caribou	2½ years ?	3 years ?	230 days (average)
Whitetail Deer	2½ years	Usually 2 years. Sometimes 1 year on good eastern ranges	210 days.
Mule Deer	2½ years	Usually 2 years. Occasionally 1 year on good nutrition	210 days.
Coast Blacktail Deer	2½ years	Same as mule deer.	210 days.
Mountain Sheep	3½ years. Possibly 2½	3 years.	180 days. (average)
Mountain Goat	2½ years ?	3 years ?	180 days.

Breeding Characteristics of the Hoofed Game Animals of British Columbia

Species	Average number of young per adult female	Period of rut	Breeding behaviour
Moose	As high as 1.3 on good ranges. (30% twinning)	Late September to early October	Polygamous to a certain degree. Probably depends upon the senility.
Elk	On most North American ranges, 1; but twinning occasionally takes place	Late September to early October.	Polygamous. Bulls acquire harems.
Caribou	Single births are the rule. Twinning probably occurs occasionally.	October	Polygamous. Bulls acquire harems.
Whitetail Deer	Twins are the rule on good nutrition.	Mid-November	Polygamous. Bucks usually with one doe at a time.
Mule Deer	Twins are the rule on good nutrition. Triplets occasionally.	Mid-November	Polygamous. Bucks usually with one doe at a time.
Coast Blacktail Deer	Same as mule deer	Mid-November	Same as mule deer
Mountain Sheep	Singles are the rule. Twinning occasionally	October to December. Varies with climate and area.	Promiscuous.
Mountain Goat	Singles are the rule. Twinning occasionally	November	

Big Game Animals

Moose (Alces americana)

Moose are one of the most widely distributed big game animals in British Columbia. They may be found from the Rocky Mountains on the east to the Coast Mountains on the west and from the Yukon border to the 49th parallel. The greatest abundance of moose however, occurs in the central interior between the 51st and 55th parallels of latitude.

For the most part, these large herds have appeared only in recent years. Widespread burning during the early years of prospecting and settlement destroyed large tracts of spruce, cedar, and hemlock climax forests. The new seral forests of aspen and willow provided vast areas of optimum winter ranges and permitted the increase and spread of moose to the south hitherto unpopulated by this large member of the deer family.

The Douglas fir parklands of the Cariboo plateau are also important winter ranges of moose. The open stands of mature firs permit enough penetration of sunlight to produce good willow growth, the key to habitable moose range. Throughout most of the areas occupied by moose the river bottoms, lake and stream margins, and willow and birch swamps provide additional browse, and in some areas, such ranges are used exclusively by wintering moose.

Densities of moose on winter ranges are largely dependent upon the quality of the range. Some large burns supporting willow and aspen carry in excess of 25 moose per square mile. Concentrations along river bottoms at times exceed 15 animals per square mile. As would be expected the high producing moose ranges are in areas of good-quality soils, as reflected by abundant plant growth.

Most moose undergo some seasonal migration from the high summer ranges to the low winter ranges in the autumn and the reverse during the spring and summer. It is known that large numbers of the moose in the Chilcotin area may migrate as much as 50 miles one way. On the other hand, some are resident the year 'round on the low ranges and their movements are very local. This situation is prevalent in many parts of the Cariboo district.

Like other animals living in diversified habitat, moose are, to a large extent, opportunists in their food preferences and eat what is available. Upland willow is the single most important winter food item on upland ranges such as burns and Douglas fir parklands. Other important browse species on upland ranges are paper birch, serviceberry, chokecherry, and aspen. Important wetland food items are red osier dogwood, arctic birch, water birch, willow, and sedges. Other plants of less importance but frequently eaten are balsam fir, Douglas fir, alder, Douglas maple, cranberry, false box, and lodgepole pine.

Summer foods of moose include less browse and more herbaceous plants. The quality and quantity of winter food are usually considered to exert more control on population behaviour than do those of summer food. From studies in Wells Gray Park there are indications however, that the quality of summer browse may also influence the productivity of moose. There is evidence of a higher frequency of twinning on the higher ranges where, presumably, the plants are of better quality.

Management - The problems of managing our moose herds in British Columbia are by no means unique and to a large extent involve human management as well. The public must be shown that our moose populations represent a renewable resource and that the annual crop cannot be harvested without seasons on antlerless animals as well as on bulls. With an ever-increasing support of public opinion, either-sex seasons can become a standard practice.

Problems of poor hunter distribution can be solved in part, at least, by varying the length of the seasons, by well-directed publicity, and a flexible system of guide restrictions. Co-ordination of all game management throughout the Province is vital to the successful management of any one species.

Public awareness should also include the habitat requirements of moose and the place of the species in a broad, multiple land use program. Until wildlife is given proper recognition in land management policies we must be opportunists and make the best of the present day moose herds. There are many timber producing areas where moose must be considered a useful by-product of forest management. On the other hand there are undoubtedly areas that would best be managed with emphasis on game production. Careful, unbiased study will best determine how lands should be managed for maximum resource production. Although management burning is not the complete answer to problems of range production for our interior moose herds it should eventually become part of a habitat management program. There is need for continued research along those lines for, although the current demands upon our moose herds hardly justify any costly habitat improvement program at this time, future circumstances will undoubtedly dictate a need for some range rehabilitation.

In 1955 the estimated moose kill for the Province was 7,000, of which approximately 1,000 were taken by non-resident hunters. Under ideal conditions of open seasons and hunter distribution this kill might well be doubled and even trebled. It is estimated that there are between 60,000 and 100,000 moose in British Columbia.

Elk (Cervus canadensis)

Rocky Mountain elk (Cervus canadensis nelsoni) are most abundant in the East Kootenay districts where the best available population estimate places the number at 20,000 head. Elsewhere, natural herds exist near the Yellowhead Pass and along the Muskwa River, the latter being the northern-most herd. Introduced herds are located in the Lardeau Valley, at Princeton, Adams River, McNab Creek on the coast, east of Okanagan Lake, and on the Queen Charlotte Islands. A small liberation near Lillooet a number of years ago does not appear to have survived. Elk

were once numerous throughout much of the southern interior as testified by remains common in many areas. It is believed that these elk were present as late as the early part of the nineteenth century. Their fate is unknown.

The Roosevelt elk (Cervus canadensis roosevelti) once present on the mainland coast as well as on Vancouver Island, is now restricted to the latter area where estimates place the number at between 1,200 and 1,500 head. These are made up of at least 30 herds of varying size.

The interior elk presently inhabit a wide variety of environmental types, the summer ranges consisting mainly of high alpine ranges, basins, slides, and burns. There is a definite tendency for the animals to move to high ranges whenever the snow leaves, presumably to feed on new grass and forb growth. Elk may however, be found on winter ranges in the summer period, at which times they may frequent water courses to a greater extent than the open, dry areas. The main summer food of elk appears to be grass and forbs, and the animals tend to move up the mountain sides as the new growth follows the receding snow line.

Winter ranges of this species in the East Kootenay consist mainly of burned-off areas at lower elevations, with an ample supply of browse plant cover. Willow, amalanchier (Saskatoon), bitterbrush, mountain maple, and caeonothus, comprise the most abundant and most heavily used plants on the ranges, although fir, pine, juniper, and other species may be eaten to the same extent depending on their abundance and the forage composition on the range. Browse comprises the main diet of wintering animals. Broken topography seems to be preferred by elk especially in areas of southern exposure and light snowfall. In other areas however, the species may be found wintering on flats along valley bottoms or even on high mountain burns with considerable snow depths.

The introduced elk of the Lardeau Valley spend most of the year in dense Columbian forests and in open and semi-open swamps along the lower reaches of the Lardeau River.

The Roosevelt elk of Vancouver Island appear to be dependent upon mature or climax forest associations of cedar and hemlock for at least part of the annual range. At present this species is associated with areas that have experienced the least disturbance by the hand of man.

Except for a few introduced herds, the interior elk regularly undergo annual migrations from the winter ranges in the valley bottoms to the alpine and sub-alpine summer ranges. On Vancouver Island migrations are more local.

Management - Proper herd control, particularly in areas where elk conflict with agriculture, and protection of winter ranges and migration routes are the major objectives of elk management in British Columbia. Making the surpluses available to the hunting public is the primary consideration in these objectives. Elk production and agriculture may conflict in two ways. Competition for forage on the elk winter range can be a serious factor limiting the productivity of elk herds.

While proper use by domestic animals and elk will often minimize competition some marginal ranges are best suited for elk production and full protection from domestic stock is then warranted.

Elk depredations upon orchards and hay stacks often are a result of mismanagement of native winter ranges. Such inroads can be checked by increased utilization of the elk herds and better livestock management which will ultimately reduce the demands upon the natural forage. Fencing elk and other game from agricultural areas is often suggested as a remedy but although this costly measure may solve the landowner's problems, it merely creates more for the game administrator. It is within reason to expect a rancher to construct game-proof fences to protect individual haystacks. This also applies to moose.

Some of the winter ranges of the Vancouver Island elk are threatened by logging and flooding, the latter resulting from hydro-electric developments. It is doubtful if anything can be done to compensate for such loss.

Mule deer (Odocoileus hemionus hemionus)

Mule deer range over most of the Province east of the Coast Mountains except the extreme northern portions. The species is most abundant in the arid valleys to the south. North of the Cariboo district its range is spotty and numbers scattered. The best ranges for mule deer in B. C. are those in the Douglas fir and yellow pine zones bordering the grasslands. Mule deer in this Province are on the northern fringe of their distribution and cannot therefore reach densities comparable to those of optimum ranges further south.

Generally, mule deer ranges are rather uniform throughout. In the Douglas fir zone carrying capacity varies with the age of the forest. There is little or no available browse in dense stands of semi-mature firs. Park-like areas of the mature forest afford better range. Openings in the mature forest, either natural or man-made, appear to be ideal features of good mule deer winter habitat. The margins of the grasslands and forests are important in this respect for they provide both food and shelter along the "edge".

For the most part, mule deer annually migrate between distinct summer and winter ranges. In some districts these treks may involve distances exceeding 50 miles one way. For example, many of the deer which winter near the Fraser River at the Gang Ranch travel from the sub-alpine and alpine summer ranges near Taseko Lake.

The winter diet of mule deer is largely a reflection of the available browse on their range and may differ from one area to another. For example, a deer wintering in lodgepole pine country may feed principally upon kinnickinick, aspen, and willow. On the other hand, a deer in the Douglas fir or Douglas fir-yellow pine types of the southern Cariboo region would probably be eating Douglas maple, serviceberry,

Rocky Mountain juniper, rabbitbush, Mahonia (Oregon grape), pasture sage, bunch grass, snowberry, and Douglas fir. On the optimum mule deer ranges of the United States, Douglas fir is seldom eaten and is considered unimportant as deer food. To what extent it is a preferred food in British Columbia is questionable. Heavy use in some areas may represent a secondary choice or, in some cases, even a starvation diet. Usually the palatable deciduous shrubs show heavy use in areas where Douglas fir has been eaten to a noticeable extent.

Management - Hunting pressure on most of British Columbia's deer herds is relatively light and emphasis must be placed on more efficient utilization. Similar to the needs of moose management, a better distribution of deer hunting pressure can be achieved through manipulating seasons and bag limits and good public relations.

Logging on many mule deer ranges is distinctly favouring the species. Openings in the tree cover and scarification of the soil resulting from logging activities stimulate the production of good deer browse and a better interspersion of food and cover results. The same factors, however, promote coniferous reproduction which eventually dominates so the increase in deer range is not permanent. Deer also make considerable use of the fir browse cut down during actual logging operations. During severe winters this may have an important influence upon deer survival in such areas.

Columbian blacktail deer (Odocoileus hemionus columbianus)

The coast blacktail is the only native deer of the Pacific slope, Vancouver Island, the Queen Charlottes, and smaller islands along the coast. It ranges the full length of the coast but is found in lesser numbers in the extreme north. North of Rivers Inlet the subspecies is the sitka deer (O. h. sitkensis). Intergradation between the interior and coast blacktails is not uncommon where the two subspecific populations come in contact. The eastern limit of distribution of the coast deer is the summit of the coast range.

The coast deer has exhibited a marked response to the effects of logging. On Vancouver Island its preferred range is on or adjacent to logged over lands, particularly during the early stages of succession following burning. It is also a deer of the thick coastal forest of cedar, hemlock, and Douglas fir in which it thrives best where openings are plentiful. During one season or another coast deer may be found in almost every forest association indicating an adaptability for survival under a wide range of conditions.

Although the coast deer ranges throughout a wide variety of plant successions, nowhere along the coast is it as abundant as on the logging slashes of the eastern half of Vancouver Island. On some of the best sites densities in excess of 40 animals to the square mile are present. The animal is also plentiful on the Queen Charlotte Islands and on some of the smaller coastal islands between Vancouver Island and the mainland.

Logging on the west slope of the Coast Mountains has not stimulated population growth to the degree that it has on the east coast of Vancouver Island. Slope and heavy precipitation are probably the basic reasons for the relative scarcity of deer on the logged-over areas of the mainland. The species here seems to thrive best in the more level areas of the Fraser Valley in close proximity to agricultural lands where it is occasionally the source of damage complaints.

The food utilized by coast blacktails varies considerably on Vancouver Island ranges. Under primitive conditions most blacktails make altitudinal summer-winter migrations and the diet changes abruptly. Forbs, annuals, grasses, and other green vegetation furnish the food necessary for growth during the spring and summer. The winter diet is mainly browse indlucing lichens, mosses, and windfall material such as cedar, broadleaf maple, etc.

Logging and subsequent burns have had a major influence upon the species particularly insofar as summer and winter diet is concerned. The spring and summer diet is still of the same type as under primitive conditions although the number of food species present is much greater. There now exists a transition period covering most of the fall months and continuing until snow covers the lower ranges. During this period varying quantities of browse are consumed. Green vegetation is also taken in considerable quantity and this improves the general nutritional level for this period. The winter diet on logged-over ranges includes more deciduous browse than formerly and therefore reduces the dependence upon conifers. Heavy conifer browsing (particularly fir) is not a healthy situation and indicates an improper relationship between deer and the more palatable deciduous food supplies. This situation can be corrected by correct harvesting of the surplus population.

The coast deer expands its range during the snow-free period to include some of the higher levels, but apart from these local movements distant migrations in the sense we know are absent.

Management - Since the high deer populations on Vancouver Island have resulted from logging mature stands of climax forest, it follows therefore that management of the coast deer must be integrated with forest management practices. The usefulness of any logging slash in terms of deer production is not permanent and at the most produces well for only 15 or 20 years. During this period the bulk of the deer will be produced during the 5 - 10 year period of slash growth at the end of which time coniferous cover begins to dominate. Because the useful life of a logging slash is limited, new range must be continually produced to replace the old if deer production is to be maintained.

The best logging practices from the standpoint of deer production are those which remove blocks of timber rather than large scale clear cutting. This produces a good variety of food and cover along the many perimeters. In addition it provides a better balance of winter and summer range and makes deer production and survival more certain during years when unusually severe winters occur.

It is necessary that we be ever aware of coast deer management problems and the influence of the timber industries on both deer production and deer harvesting.

Whitetail deer (Odocoileus virginianus ochrourus)

The whitetail deer is restricted in its distribution more or less to the southeastern portion of the Province with the center of abundance in the Rocky Mountain Trench. It ranges west as far as the Okanagan area.

Although mule and whitetail deer inhabit the same general areas in the East and West Kootenay districts there is some difference in the ecological preferences of the two species. The whitetails favor the dense thickets of the valley bottoms, whereas the mule deer prefer the open, parkland slopes of the valleys. In this respect, whitetail deer are adaptable to the dense Columbian rain belt forests predominating in the West Kootenay and Arrow Lakes regions. In these areas, however, mule deer are the most numerous.

Although whitetail deer do expand their ranges during the snow-free periods to include much of the higher levels of the valleys they do not exhibit the marked migratory patterns of the mule deer.

Summer food of the whitetail consists mainly of grasses and forbs. This preference is very marked in the spring when large numbers of whitetails gather on slopes and other areas at the first sign of new growth. The species will also invade swamps and marshes to obtain growing sedges and other aquatic plants. Alfalfa is a favored food, a fact which predisposes crop damage where concentrations of this species occur.

Winter food consists largely of browse although cured grasses and other plants may be taken if available.

Management - Because whitetail and mule deer occupy the same areas management practices and policies for the two species must be closely related. Problems peculiar to one species, however, are sometimes encountered. Hunters, particularly local residents, prefer the sporting quality and meat of the whitetail to the mule deer and there is a definite selection apparent. With increased hunting pressures the effect of differential preferences should, however, be negligible.

Whitetail deer are particularly vulnerable to train collision, dog predation, and poaching, since they inhabit the bottoms of narrow valleys along the roads and railway right-of-ways. The volume of such losses can be reduced by replacing them with a legal harvest.

Mountain Caribou (Rangifer arcticus)

In British Columbia, the mountain caribou (Rangifer arcticus montanus) ranges throughout the southern Rocky Mountains from the Pine River south to the Wood River. They are present in lesser numbers in the Selkirk Mountains of southeastern British Columbia and in the Cariboo Mountains of the central interior. This race also occurs on favorable mountain spurs of the coast range from Morice Lake south to the Bella Coola River.

The Osborn caribou (Rangifer arcticus osborni) occupies the mountain systems of the Omineca and Cassiar regions north to the Yukon border.

Mountain caribou are dependent upon the climax vegetation types for habitat. They summer in the sub-alpine and alpine ranges of the mountains and winter at lower levels in the spruce-balsam and hemlock-cedar forests. The older and more decadent the forest, the more productive it is for lichens, a major winter food item, and therefore, the more attractive to caribou. This game species was much more widespread during the early years of exploration and settlement in the Province. As an example, even as late as the early 1900's caribou were hunted in the Lillooet-Taseko country where they are now unknown. This is but one of the many areas wherein the herds disappeared.

The decline of caribou was undoubtedly associated with the widespread destruction of the climax forest types used by the animals as winter range. Fire, the same agent responsible for the increase of moose range in the Province, was responsible for the disappearance of caribou from many of their former haunts. The seral forests that replaced primeval virgin stands have apparently not fulfilled the requirements of winter range. This sequence of events has also been apparent in Alaska and parts of the Yukon.

Management - The most important phase of caribou management in British Columbia entails the protection of the climax forests so vital as winter range. Logging and fire in forests frequented by these animals will most certainly be detrimental. Caribou movements must be watched and their established winter ranges protected.

It is encouraging to note that small, pioneer bands of mountain caribou are becoming established in areas where they have been absent for several decades. In addition it is apparent that some of the larger herds have increased during the last few years and are contributing more to big game hunting in the south.

Bighorn Sheep (Ovis canadensis)

The Rocky Mountain bighorn (Ovis canadensis canadensis) is native to the western and eastern slopes of the Rocky Mountains from the international border north to and approximately 150 miles south of the Peace River. There is also a natural herd at Sheep Creek near Mount Robson. This subspecies was introduced from Banff to Squilax and Spence's Bridge in 1927. In 1933 an introduction was made at Adams Lake.

California bighorns (Ovis canadensis californiana) are to be found only in the south-central section of the Province from the border north to the 52nd parallel near Williams Lake.

The best estimates available place the numbers of Rocky Mountain bighorns in British Columbia at between 2,000 and 3,000 head and the California bighorns at approximately 1,200 animals.

Summer range of most bighorn sheep, particularly those of the Rockies, consists of sub-alpine and alpine vegetation. Winter range is usually associated with the dry forest types or the ecotone between the dry forest and the grasslands. Typical winter range of bighorns includes rocky outcrops used as escape terrain, coniferous cover, and grassland whether climax or fire-induced. Topography of sheep ranges is usually rough with good interspersion of steep slopes and benchland.

As indicated above, bighorns usually migrate to high summer ranges each year. Animals in some of the California bighorn bands ranging in the arid grassland valleys, however, do not migrate and their annual movements are very local.

Bighorns eat a wide variety of plants including grasses, forbs, and browse at all seasons. As a single class, grasses usually contribute the most to the diet of these animals and may be represented by as much as 75% of the winter diet. Pasture sage has been found to be of considerable importance to wintering California bighorns west of the Fraser. Other plants eaten are: several species of grass, rabbitbush, kinnickinnick, Douglas fir, chokecherry, and big sage, in addition to numerous forbs. Summer food of bighorns consists mainly of grasses, sedges, and forbs.

Management - Protection of winter ranges is one of the foremost management considerations for bighorn sheep. In their gregarious nature, bighorns favour rather discreet areas and it is apparent that the welfare of the species is largely dependent upon the conservation of these key areas. Excessive use by domestic livestock and other competitors for the natural forage cannot be tolerated.

Unfortunately, the best winter ranges of California bighorns occur on the grasslands of the major valleys and cannot be considered wilderness areas. For the most part, these lands are under private

ownership or are leased for grazing rights. Consequently multiple use is inevitable, and the best course to establish is one of a clear understanding of the requirements of the bighorn among the grazing administrator, the ranching operator, and the game administrator as well as the general public.

Management of California bighorn is currently being furthered by a transplanting program designed to establish new bands on suitable ranges in the southern interior. Large increases in numbers of existing bands cannot be expected, and the best over-all increase can result only by expansion of occupied range.

The three-quarter curl regulation on California bighorns has made it possible to allow an open season on the accessible bighorn bands of the Okanogan and Similkameen. Regardless of hunting pressure an adequate survival of rams is ensured. West of the Fraser, the same regulation is designed to promote better selection of trophies, the emphasis in production being placed on quality rather than quantity.

Thinhorn Mountain Sheep (Ovis dalli)

The stone sheep (Ovis dalli stonei) ranges through the northern part of British Columbia in the mountains of the Cassiar, Omineca, and Peace River district. Near the Yukon border it integrades with the dall sheep (Ovis dalli dalli) to produce the varied-coloured fannin or "saddle-back" sheep which is common east of Atlin Lake. The pure dall sheep is found only in the extreme northwestern corner of the Province near the Alaska panhandle.

Human activities have had little influence upon the sheep of the north or their habitat. Development of mineral resources will undoubtedly create more roads and hunting pressure in Stone sheep areas. Increased demands will dictate a greater need for surveys and inventory of northern game species..

Mountain Goat (Oreamnos americanus)

The three races of mountain goat (or mountain antelope) are distributed over the mountainous areas of the Province, there being few mountain systems without at least a few goats. This distribution is by no means continuous and undoubtedly reflects the suitability of habitat involving year-'round ranges supplying the requirements of the species.

Human activity has had no appreciable effect upon the environment of the mountain goat and most of its range remains in the primeval condition. In a few instances, forest fires in sub-alpine timber have no doubt favoured the goat habitat. However, since most of the goat range is situated above timberline this effect is probably not important.

Management - Apart from effecting good distribution of hunting pressure and proper utilization, little can be done to manage our goat herds. Small herds near population centres and travelled highways may have a high aesthetic value and warrant special protection. Since goat are available in so many other areas, such protection might be justified. It should be pointed out, however, that many game herds can be hunted without losing their aesthetic value.

Grizzly Bear (Ursus arctos horribilis)

The grizzly bear inhabits virtually all the alpine and subalpine areas of the Province with the exception of Vancouver Island and the Queen Charlotte Islands. On the coast they are found down to the limits of tidewater but in the central interior they are usually confined to mountainous regions. The species as a whole appears to show considerable ability for adaptation to varying environmental conditions.

Management - The grizzly bear is rated high as a game animal and as such, emphasis should be placed on the conservation of its habitat and intelligent use of surplus animals. Domestic stock raising and grizzly bears are not compatible, and careful consideration should be tendered before this type of agriculture is encouraged in grizzly bear areas. There are undoubtedly areas in existence today where stock-raising is being attempted on marginal land at the sacrifice of grizzly populations. It is believed that such pursuits should have been discouraged at the outset. Regions designated as wilderness areas, wherein wildlife is given primary consideration would do much to maintain grizzly populations and habitat, as well as that of the entire wildlife community, and would constitute the basis for a lasting wilderness wildlife management program.

In areas where grizzly threaten to conflict with livestock operations and control is necessary, efforts should be made to transfer hunting pressure onto these offenders. Good publicity is often the key to successful management.

Black Bear (Euarctos americanus)

The common black bear is distributed over the entire Province. It may be encountered in all vegetation types and almost all elevations above sea level. Altogether, there are 5 subspecies recognized.

Management - The black bear in agricultural areas is usually considered a potential predator and not without reason. Therefore, it is not protected at any time, except in certain Parks. Unfortunately, this persecution is carried to areas where the black bear does little or no harm to anyone (certainly not as much damage as deer do to orchards or elk and moose to haystacks). Wanton killing is not part of good game management. We must never lose sight of the sporting and aesthetic

qualities of wildlife and in the areas of the Province where the black bear is not likely to conflict with man's activities, there would seem to be little reason for encouraging wanton killing through having no closed season. At all times effort should be made to encourage the public to solve and prevent their predation and game damage problems themselves. Quick disposal of dead livestock carcasses will frequently prevent subsequent predation.

Perhaps if more of the general public were aware of the epicuristic qualities of the black bear there would be little need for additional control measures in agricultural areas.

Cougar (Felis concolor)

Generally speaking, the cougar ranges over the southern half of the Province including Vancouver Island. Occasionally they are present in the Peace River Block and unauthenticated reports of cougar activities have been received from as far north as the Taku River drainage. The three main areas of cougar concentration in the Province are Vancouver Island, the southeastern portion of B.C. from the Arrow Lakes east to the Rocky Mountains, and the south-central Cariboo from Kamloops north to Quesnel. The latter area also includes a considerable portion both east and west of the Fraser River. In short, the cougar appears to inhabit the deer areas of B.C.

The diet of the cougar is mainly deer or other big game but is supplemented by the so-called "buffer" species such as wild rodents, rabbits, birds, etc.

Management - Cougars have been classed as predators in British Columbia for many years and have been hunted and destroyed indiscriminately. As a sporting animal, the cougar has few equals. This type of sport involving the use of trained hounds can be very thrilling but usually requires much hard work. Unfortunately, cougar hunting by parties of sportsmen guided by cougar hunters has been a business of little or no success. Few cougar hunters in B.C. have tried to establish this sport in the past and particularly during the cougar decline of the last 4 years. Bounty payments suggest a 16- or 17-year cycle in cougar population fluctuation with low animal numbers in 1925, 1941, and an impending low evident for 1957. The high points appeared in 1931 and 1948. The Vancouver Island population trend appears to lag behind the provincial trend by as much as 5 years.

In the management and control of this animal current thought has been directed toward removing the bounty from cougar and declaring this cat a game animal.

WOLF (Canis lupus)

The present range of the wolf in B.C. includes all of the Province except that area south and east of Kamloops and the Rocky Mountains, The Queen Charlotte Islands, and some of the coastal islands. In former times the range probably extended over the whole of the mainland with the main concentrations lying north of Quesnel and extending south through the Chilcotin Plateau and the upper Fraser River.

Management - For many years the wolf has been classed officially as a predator although it has been maligned and misjudged to a greater extent than is possibly deserved. On the debit side the wolf has done heavy damage to livestock, has decimated small or isolated game herds, and has been destructive of fur bearing species. It is also a carrier or rabies and a spreader of hydatid disease. Various types of destruction have been used against the wolf because of his real and fancied depredations and they have resulted in a serious depletion of the former large populations. The species is one of the most susceptible to poisoning as it operates characteristically as a family unit or a group of family units which could be wiped out at once.

On the credit side, the wolf may have a desirable effect on game populations. Furthermore, the wolf is an integral part of our wildlife and from an aesthetic point of view should be assured a place of permanence at some responsible level among our native fauna. Now that the wolf bounty has been dropped a form of "wolf management" can be practiced. Areas of little or no game hunting will be kept at what is considered to be an "adequate" wolf population level. Conversely, wolves will not be tolerated in heavily hunted or stock-raising areas. In this way material damage will be kept to a minimum and the wolf will still be with us.

COYOTE (Canis latrans)

The coyote has increased its range during recent years and now occurs over the whole of the Province with the exception of the coastal and off-shore islands. This increase in range typifies the adaptability of the animal and partially explains its ability to survive in large numbers in the face of persistent control measures. Originally the coyote was a plains animal but is now found in almost every corner of the Pacific northwest.

Management - The coyote can be a very important predator on wildlife and domestic stocks. Though usually confining his activities to the younger age classes of prey groups this animal is quite capable of killing the adults of some of the larger species. Damage by coyotes can be extremely high and costly and in the past has put many sheep raisers out of business.

Although coyotes show more than average animal intelligence they are extremely susceptible to trapping and poisoning of the opera-

tions are carried out with skill. Since the introduction of Compound 1080 the destruction of coyotes, in wholesale quantities, has been much more easily accomplished than when less subtle poisons were used.

The recent bounty system focussed considerable attention on the coyote and subjected the species to heavy losses. To cope with bounty pressures it was necessary for organized controls to be extensive and severe. Since abandoning the bounty system controls may be reduced and the coyote population allowed to increase. Such increases would, of course, be tolerated only as long as damage to domestic stock or to game remained at a low level.

A popular and erroneous lay opinion exists with regard to the effect of the coyote in the control of rodents. While this predator may destroy many rodents, studies show such destruction to be ineffective in reducing rodent populations to a measurable degree.

In spite of his predatory nature the coyote is not without supporters and it is probable that with little help this animal will always be part of our wildlife.

Trophy Rating

The interest in trophy heads of game animals is universal but unfortunately the methods used to measure or rate trophy quality are not. In the past there have been several different European and a few North American systems of trophy rating, all of which make for considerable difficulty in assigning a head its rightful position in both international and local competition.

All systems appear to incorporate similar basic considerations in their methods of ranking. Size, symmetry, conformity to type pattern for the species, are the essential elements but the manner in which these qualities are assessed varies with each system.

In North America there now exists the rating system promoted by the North American Big Game Committee and used in the annual Boone and Crockett Club competitions. This system features scoring based on specific measurements which are recorded on a special form for each game species. These measurements are readily converted to a score of total points which enables comparison of a particular trophy with those of others in the same class or group. The method is now the generally accepted standard of rating North American big game and provides a fair and practical basis of comparison and assessment.

Among antlered game, competition is divided between animals having typical or regularly developed heads and those with non-typical or irregularly developed heads. Each group is judged separately and with slight differences in scoring.

There is no doubt that many heads of trophy and record class have never been entered for competition partly because of diffi-

culty in bringing the head in from the field and partly because many hunters have been indifferent to or ignorant of the high calibre of the game animals they have obtained. The following list is given to provide some idea of the measurements characteristic of record heads. If should be mentioned that the Boone and Crockett competition is held annually and heads which may score lower than those listed below could be records for the particular year in which they were entered for competition. Blank scoring sheets for all British Columbia big game species are available from the Vancouver office of the Game Department.

Records of North American Big Game
(According to Boone & Crockett Club scoring system)

Species	Number of points	
	Typical heads	Non-typical heads
Deer, White-tailed	150	140 : 20 = 160
Black-tailed	100	
Mule	170	170 : 30 = 200
Wapiti	330	
Caribou, Mountain	350	
Woodland	295	
Barren Ground	350	
Moose, Canada	180	
Alaska	200	
Sheep, Bighorn	175	
Stone	160	
White	160	
Goat, Rocky Mountain	47	
Bear, Grizzly	23	
Black	20	
Cougar	16½	

Upland Game Birds

Ruffed Grouse (Bonasa umbellus)

The ruffed or willow grouse is the most widely distributed game bird in British Columbia. Five subspecies of the ruffed grouse are recognized. From sea level to timber line and from the arid sagebrush valleys to the rain forests, this adaptable bird occurs along stream margins or in other suitable deciduous forest types. Typically, it is associated with the aspen and willow uplands.

Settlement has undoubtedly created considerable ruffed grouse habitat in Central British Columbia in the same manner it has aided the development of moose ranges. On the other hand, land clearing and heavy grazing in the bottom lands has destroyed a certain amount of habitat. This has, in part, been compensated by the increase in sharptail grouse habitat as a result of land clearing and subsequent grain growing in many areas.

Because much of the ruffed grouse habitat has been fire-induced, and is of a seral type, it is subject to changes generally from a high to a low productive level. The change is very slow and the effect on the grouse population may not be detected except over a long period of time. Natural fluctuations of numbers which are inherent to the species tend to obscure changes effected by variations in habitat.

Management - Hunting has never been a major factor controlling ruffed grouse numbers because the effect of diminishing returns is most evident and a large part of the population is never hunted by reason of its inaccessibility to even the present-day hunter. While grouse populations are in the peak years of their cycle the greatest benefits can be realized through maximum utilization. Peak populations will ultimately crash regardless of hunting pressure and there is some evidence that heavy shooting may forestall and even reduce the severity of the decline.

As pointed out above, closing the season when the birds are at a low is not justified and will not influence their return to high numbers.

Little can be done to control or create ruffed grouse habitat in British Columbia. It will be many, many years before hunting pressure will justify any expense to produce new grouse range. Good grazing practices on timber ranges and along water courses is, however, good conservation of grouse habitat. In addition, logging will undoubtedly continue to produce openings in the heavy timber which become attractive to ruffed grouse.

Sharp-tailed Grouse (Pedioecetes phasianellus)

Sharp-tailed grouse, commonly but erroneously called "prairie chicken" are found from the International Boundary east of the Cascades north to the Peace River Parklands. They are most abundant in the parklands and grain-farming areas of the Peace River, Nechako Valley, and in the Cariboo district. Sharp-tailed grouse habitat is largely confined to areas possessing a good proportion of open grassland, cultivated land or wild hay meadows.

Agricultural activity in the form of land clearing and grain growing has unquestionably opened up considerable sharp-tailed grouse range, particularly in the Peace River Block and Nechako Valley. To the south, in the Cariboo, although some land clearing may have improved sharp-tail range there has been some loss of native grassland habitat due to excessive grazing. The same situation probably applies also to the East Kootenay district.

Management - Under current hunting pressures and seasons the escapement in most sharp-tail grouse flocks is high and risk of overshooting is non-existent. Accessible flocks in the Cariboo region receive the heaviest hunting pressure and it is conceivable that some of these are sustaining a maximum yield. Smaller flocks seem to be more vulnerable to hunting. It should be pointed out, however, that a certain proportion of "family unit" flocks will have to be sacrificed if a workable open season is to be effected. It is both wasteful and poor management to have restrictions governed by a handful of game animals, be they grouse or moose, living beside the roads.

Good range management practices will help to maintain sharp-tailed grouse habitat throughout the grasslands. With continued land-clearing and cultivation, there should occur increases in potential habitat for this species.

Established dancing grounds should be located and every effort put forth to conserve these and avoid unnecessary disturbances in their proximity.

Sooty Blue Grouse (Dendragapus obscurus fuliginosus)

The sooty blue grouse is resident on the mainland coast, coastal islands, and Vancouver Island. Birds of this species spend the winter months in the coniferous forests at higher levels and descend each spring to the natural openings and logging slashes to nest. The abundance and extent of openings with suitable herbaceous vegetation and insect life necessary during the reproductive cycle apparently determine population densities in most areas.

On Vancouver Island blue grouse are a by-product of logging and occur in maximum numbers during the first decade of seral growth. Generally, the productive areas of cut-over land of the late 1930's and '40's are rapidly declining. The habitat is no longer as suitable for

blue grouse and the birds present are less available to the hunter due to the thick undergrowth.

It appears that the typical "patch logging" practices (approximately 500 - 600 acres) supports considerably fewer breeding birds than adjacent clear-cut land. The 70 - 90-year cutting cycle of most forest management areas will probably produce a low, although constant, number of birds which in total may easily surpass the tremendous but short-lived populations which have followed the extensive clear cuttings of earlier years. The sustained yield system of logging may allow a much longer effective season for birds will probably be found in the new habitat conditions the year 'round.

Whether or not logging will bring about an increase of birds on the west coast and the north central portion of Vancouver Island remains to be seen. It is possible that the rapid growth rate of the ground cover in these areas will impede colonization for the coastal blue grouse prefers open ground. The vast areas involved, however low the returns per unit of area, will probably produce enough birds to augment the Island-wide harvest.

In recent years (1953-56) the harvest of blue grouse on Vancouver Island has averaged 50,000 - 70,000 birds, but this number is considered to be about one-quarter of the available crop. As productive areas diminish such a yield may well represent the maximum allowable. While the future for Vancouver Island blue grouse does not look too bright, by stepping up the harvest efficiency we may sustain the present yield or increase it despite a numerically lower population.

Management - The harvest of blue grouse involves a compromise between opening before the fall migration and late enough to allow the birds to be of sufficient size. By mid-July sufficient facts are on hand to predict the size of juveniles and an opening day can be chosen accordingly. A complicating factor to early September openings, which are necessary for maximum utilization, is the fire hazard. Immediately prior to the proposed opening of blue grouse, representatives of the B.C. Game Commission, B.C. Forest Service, B. C. Loggers Association, and the Organized Sportsmen meet to assess the situation in respect to the fire hazard. If hazardous conditions prevail a decision is made relative to opening the season. The best solution to the problem is to plan for as early a season as possible considering the biology of the bird and re-assess this date in the light of forest fire hazard just prior to the opening.

Blue grouse pose a problem in harvesting for adult males which form a considerable portion of the population, probably 20 percent. These contribute little to the harvest as they have migrated to the mountains by the time the season opens. In the forest countries of Europe that have grouse with similar habits spring shooting is the accepted manner of taking males.

Dusky Blue Grouse (Dendgragapus obscurus pallidus

The blue grouse of the interior is most common to the Douglas fir zone of the southern interior. It occurs on the fir ridges of the main valleys and along the fringes of the grasslands. Habitat of this species is relatively stable compared to that of the Vancouver Island blue grouse.

Management - A large proportion of the best blue grouse habitat in the interior occurs on either privately owned or leased land. Consequently, there will always be some areas with little or no hunting pressure since some posted land is inevitable. This points to a need for the protection of access to Crown lands which may be hunted and the actual preservation of such lands for public recreation. Grazing is about the only activity which conflicts with hunting and with judicious setting of seasons, this conflict is not great enough to justify closing such areas to hunting.

Escapement in hunted blue grouse populations is high and it is believed that the average hunter is neither skilled, persistent, or ambitious enough to overshoot interior blue grouse regardless of season or bag limit. Rather than a measure to prevent overshooting, big limits are useful in that they help to distribute the "easy" birds among more hunters.

Blue grouse in the South Central Interior exhibit an erruptive or possibly cyclic population pattern. Whether the peaks of these fluctuations always coincide with the peaks in the willow grouse cycles has not been fully demonstrated by either records or observations. Blue grouse also "flock" in the interior in large flocks or aggregations similar to the sooty grouse on Vancouver Island. It is significant to note that areas that experience "flocking" in blue grouse appear to experience a marked decline, if not almost total disappearance, of the birds the following year. If blues are abnormally abundant in large flocks one year one may expect few in that area the following year. It is not known if these aggregations of birds perish or whether they disperse over new territory and so maintain population distribution. It is likely that a vast majority of the birds do perish before the following spring for on dispersal many will scatter into unfavourable habitat.

Franklin and Spruce Grouse (Canachites canadensis franklini and C. c. canadensis)

The spruce grouse is resident in the northern half of the Province and the Franklin grouse in the southern half, east of the summit of the Coast Mountains. These two sub-species typically occur in lodgepole pine and spruce forests at higher elevations. Unlike the ruffed grouse they are not so dependent upon the seral stages of forest growth.

Few, if any, hunters deliberately seek the "fool hen" as it is commonly called and any birds which are killed are taken incidental to

other hunting. Both table and sporting qualities of the bird are low and while more desirable species are available the Franklin grouse will not be an important game bird in British Columbia.

The bag limit on Franklin grouse as well as on other grouse species in the interior has little bearing on the over-all kill since hunters seldom achieve the allowable limit. As a rule of thumb, it is believed that when the limit imposed on any upland game species can be regularly killed by average hunters (throughout the season) then the limit is too low to permit an adequate harvest.

Ptarmigan

Three species of ptarmigan occur in the Province. The white-tailed ptarmigan (Lagopus leucurus) is restricted to alpine habitat in summer but visits adjacent lowlands in winter. It occurs throughout the Province except on the Queen Charlotte Islands. The rock ptarmigan (Lagopus mutus) is restricted to alpine areas mainly in the northern part of the Province. The willow ptarmigan (Lagopus lagopus) is also found on the alplands but in winter it visits adjacent lowlands. Its range extends south to the Chilcotin region and includes Porcher Island in Queen Charlotte Sound.

In view of the inaccessibility of their habitat, ptarmigan experience little hunting pressure. The hunters who penetrate their alpine ranges are primarily seeking big game and are for the most part uninterested in ptarmigan hunting. Open seasons synchronized with those of big game are most practical. Large bag limits are in order.

Ring-necked Pheasant (Phasianus colchicus)

The first introduction of pheasants into the Province was made in 1882. Since that time virtually all available or suitable habitat has been stocked. Many of the early releases resulted in the establishment of local populations but successive liberations following these have proven of little apparent value in increasing pheasant numbers. Obviously, annual additions to populations at carrying capacity yield little or no benefits.

The bird is restricted in its distribution to farming districts. On Vancouver Island it occurs throughout the Saanich peninsula, in the lower Cowichan Valley, and north along the east coast of the Island wherever suitable habitat exists to as far north as the Oyster River.

On the mainland the species is spread widely throughout the lower Fraser Valley, in the valley of the South Thompson River, Okanagan Valley, and the Grand Forks and Creston districts. The northernmost occurrence of the species is at Alkali Lake in the Cariboo. Birds have

been released in the Peace River district and in the Bulkley Valley but only a few have survived the rigors of the northern climate and the population cannot be considered as established.

As indicated above pheasants are a product of the agricultural lands and the productiveness of their habitat is largely a function of the type of agriculture practiced. Generally, pheasant habitat has diminished in quality during the past two decades as a result of more intensive land use. "Clean" farming and sprinkler irrigation systems have allowed the removal of valuable food and cover so necessary for wintering pheasants throughout much of its range. This trend continues.

The problem is complicated by the fact that pheasant hunting as well as pheasant production is dependent upon the co-operation of the landowner. The landowner cannot be expected to undertake costly pheasant habitat improvements without some compensation, especially when it will result in more hunters on his property and the type of disorder which often goes with them.

Public pheasant hunting is becoming more restricted as more land becomes posted in its entirity or restricted to private groups of hunters. This trend is most evident on the lower mainland, particularly Lulu Island, Sea Island, and parts of the Delta.

The field of pheasant management at this time is largely one of public relations. Good farmer-sportsmen relations must be promoted at all times if pheasant hunting for the public os to remain a reality. Both groups must learn the value of true sportsmanship and fair play.

Chukar Partridge (*Alectoris graeca*)

The chukar partridge was introduced into British Columbia for the first time in the Thompson Valley and south Okanagan in 1950. The response has been excellent, especially in the Thompson Valley where its numbers soon equalled those of the long-established European Partridge.

The species is native to India and Asia where its 22 subspecies range over a wide variety of climates and habitats. The race now in B.C. is best suited to the arid, sagebrush country with a light snowfall and good interspersion of rocky escarpment. In this Province the chukar is occupying an ecological niche which for the most part has been barren of any game bird. Consequently, any addition to the game bird population made by this species will be made without risk of displacing another.

At this time it is difficult to predict the ultimate success of this species in terms of a contribution to the hunting and recreational resource of the Province. Even assuming the birds can be maintained as shootable populations, it will probably require a good number of years to develop the special type of hunters required to make use of the resource.

Providing the chukar program in British Columbia is a success, there will be a need for suitable publicity to gain the interest of hunters. Developing a resource at considerable expense which will not be used by anyone is not practical management.

In areas where both "Huns" and chukars occur if an open season is declared upon one species, it should also be open for the other, with a smaller bag limit if need be, for the inexperienced hunter cannot distinguish between the two in the field.

European or Hungarian Partridge (Perdix perdix)

The "Hun" or European grey partridge was first introduced to British Columbia in 1905 near Vancouver. Since then it has been released at numerous points in the southern part of the Province and as far north as the Cariboo and at Vanderhoof. A few small flocks persist on Lulu Island, Delta, and Saanich Peninsula. However, the only areas where birds are abundant enough to provide hunting are the Thompson Valley, Okanagan Valley, Grand Forks district, and the area near Keremeos. It also occurs in fair numbers in the Nicola Valley about Merritt.

The distribution of this little exotic game bird is restricted for the most part to cultivated or semi-agricultural areas. Grain growing areas provide preferred habitat.

Despite the fact that it has high sporting qualities relatively few hunters seek the "Hun" in the few places it can be hunted successfully in British Columbia. Since its numbers will never be high, it will never become an important game bird in the Province in terms of numbers of hunters seeking it but it should continue to provide excellent sport for the few people who are aware of its sporting and other qualities.

Because it is largely dependent upon cultivated land and hence private land, for optimum habitat, little can be done in the form of habitat management. Rather, we must take advantage of the allowable harvests when and where they are available.

California Quail (Lophortyx californica)

The distribution of California quail is exceedingly limited. On the coast this species is confined to a few areas about Duncan and the southern portion of Vancouver Island. In the interior populations of any account are present only in portions of the Okanagan Valley and about Keremeos. The best supply of birds is to be found in the Oliver-Osoyoos area.

Like the European partridge, quail numbers will always be few

and can best be managed by taking advantage of what surplus may occur. In this way the occasional hunter who appreciates the sport of quail hunting can take advantage of the open seasons on these small game birds.

Band-tailed Pigeon (Columba fasciata)

The band-tailed pigeon is one of the migratory game birds visiting parts of this Province from early spring until the termination of nesting and the rearing of young. Southern migration of this species from the Province begins in late August or early September.

Seasonal distribution of band-tails is confined largely to the southern mainland coast and coastal islands. It has been recorded as far east as Spuzzum and as far north as Terrace.

The bird frequents mixed coniferous-deciduous forest associations along the coastal fringe and about many of the islands. On its northern migration it is often seen in flocks of several hundred individuals throughout much of the agricultural area in the Fraser Valley. During these transient visits this bird is often the subject of complaint by farmers who claim it to be destructive of certain early seeded crops. This accusation has not been entirely substantiated by such investigations as have been undertaken.

Limited food studies show the band-tailed pigeon to have a high preference for the succulent fruits of elderberry, salal, Oregon grape, and similar berries. Acorns of the Garry oak are also taken in the diet of the birds about the Gulf Islands.

Management - This species, being rather limited in distribution and relatively low in availability, does not contribute in large measure to the game harvest. Comparatively little is known concerning its biology in British Columbia and suggestions for management of the species are at present necessarily restricted.

As it appears to be responsive to phenological conditions insofar as its southward migration is concerned, harvest of the bird must try to coincide with the peak of fall migration. This is often complicated by migratory bird regulations and restrictions in the interests of forest fire prevention which prohibit the hunting of band-tails before Sept. 1. In some years this is too late to effect a satisfactory local harvest.

Waterfowl

Ducks

The ducks occurring in British Columbia may be divided into three arbitrary groups, the fish ducks or mergansers, the diving ducks, and the pond or dabbling ducks.

The diving ducks are represented in the Province by the greater and lesser scaup, the American and Barrow's golden-eye, the bufflehead, the canvasback, the old squaw, the harlequin duck, the redhead, and the ring-necked duck. Of these the canvasback, the redhead, and the ring-necked duck are the most palatable.

These ducks are characterized by a large lobe on the hind toe, legs set well back on the body, and inability to rise quickly from the water without a "run". They dive to secure their food, and most of them frequent larger bodies of water including the sea. In coastal areas the diving ducks feed largely upon animal life, chiefly marine molluscs, which often renders the flesh unpalatable. In the interior, however, some of these birds are good to eat.

Many of the divers are found during the spring breeding season in the Cariboo parklands and the Peace River parklands. They remain there until the early fall and then move out to more southerly regions in and beyond British Columbia. Large winter concentrations of scaup, golden-eye, and scoters are common along the coastal waters of the Province particularly in the Gulf of Georgia region.

The pond or dabbling ducks are represented in British Columbia largely by the mallard, the green-winged teal, the shoveller, the baldpate or widgeon, the pintail, and to a lesser extent the gadwall, the cinnamon teal and the blue-winged teal.

These are characterized by a small lobe on the hind toe, legs situated centrally on the body, and the ability to rise straight into the air from a sitting position. In addition, they feed largely on land or in shallow ponds where they secure their food by tilting the tail upwards while the head and neck are stretched below the surface.

The pond or dabbling ducks feed largely upon aquatic plants, grains, grasses, and vegetable food. Occasionally, some, like the mallard feed upon decaying salmon or salmon spawn in the coastal areas, which renders them unfit for food. On the whole, however, the dabbling ducks are palatable wherever found. Most of them are wary yet respond well to decoys and most of them are swift fliers.

Large winter concentrations of mallards, pintail, widgeon, and green-winged teal may be found in the delta section of the Fraser River and throughout the Fraser Valley and as far east as Chilliwack. This single region is perhaps the most important contributor to the annual harvest of ducks in British Columbia.

Geese

The geese of British Columbia are represented by the greater Canada, lesser Canada, cackling goose, white-fronted goose, snow goose, Emperor goose, and black brant. Of the foregoing species Canada geese, snow geese and black brant are the most important to waterfowlers.

The main breeding grounds for most of the Canada goose group lies in the northern section of British Columbia in and beyond the Peace River parklands. Other nesting grounds are in parts of the Kootenay district.

Winter concentrations of Canada geese occur at the heads of many inlets and along the coastal margins of the mainland, Vancouver Island, and the Queen Charlotte Islands. The largest wintering populations of snow geese are found off the mouth of the Fraser River in the vicinity of Steveston and Ladner.

Black brant are transient along the coast in spring and are present during some of the winter months in relatively small numbers on coastal sections of Vancouver Island, the Queen Charlottes, and in Boundary Bay in the municipalities of Surrey and Delta.

Swans

The rare trumpeter swan and the smaller, more abundant whistling swan, are also found in B.C. Most of the trumpeter swan population extant occurs in this Province.

GAME MANAGEMENT REFERENCES

As useful as it might be, it is not practical for every game man to own a complete wildlife reference library. The cost is prohibitive. Many of us are far removed from any library facilities whatsoever, and we must select a few publications which we can afford and which will prove most useful for our particular need.

Three references dealing with British Columbia mammals, upland game birds and North American waterfowl respectively, have been mentioned and every person in wildlife work should avail himself of these. One additional book is also considered a "must". It is Durwood Allen's "Our Wildlife Legacy." Published in 1954, it sells for $5.00. This excellent book discusses the problems and ramifications of modern wildlife management in an easy-to-read manner and leaves the reader with a clear grasp of the situation. If a person can afford but one book on wildlife, then this should be his choice.

Acquisition of additional reference books will depend largely upon the degree of the individual's own interest and his specific tastes. Some may be interested primarily in big game or predators, others in upland game or waterfowl.

References similar to "Our Wildlife Legacy" are listed below with a few brief comments. They are arranged in their considered order of usefulness to the wildlife field worker in British Columbia. The given cost is not necessarily exact. Many are quoted from the current Pierce Book Co. catalogue.

"Wildlife Conservation" by I. N. Gabrielson, 1941. The MacMillan Co. 264 pp., 32 pls. $4.75.

"Wildlife Management" by I. N. Gabrielson, 1951. The MacMillan Co. 286 pp., 40 photos. $4.75.

These are two excellent non-technical books which deal with basic facts in wildlife conservation and management. In his first book, Gabrielson considers that there are three concepts that form the basis of the conservation movement. They are: "(1) That soil, water, forest, and wildlife conservation are only parts of one inseparable program; (2) that wildlife must have an environment suited to its needs if it is to survive; and (3) that any use that is made of any living resource must be limited to not more than the annual increase if the essential seed stock is to be continually available."

His latest book "Wildlife Management" covers all the broad phases of the field from research to public relations. The sections dealing with education, sportsmanship and administration are strongest. Like Allen's "Our Wildlife Legacy" Gabrielson's two volumes are full of

ideas which can be readily put over to the public without a lot of synthesizing beforehand. They are well worth owning by anyone, be he a professional wildlife man or hunter and fisherman.

"Game Management" by Aldo Leopold, 1933. Chas. Scribner's Sons, 512 pps., 5 pls., 32 figs., 53 tables. $7.50.

Aldo Leopold contributed much of the foundation for modern concepts of game management. His book has always been considered an authority and is well worth owning.

"Wildlife Management" by R. E. Trippensee. McGraw-Hill Book Co., 2 vols.
(1) Upland Game and General Principles. 489 pps., 71 tables. 1948. $6.00.
(2) Fur Bearers, Waterfowl and Fish. 572 pps., 147 illus., 40 tables. 1954. $7.50.

In these two volumes, the author has attempted to assemble all the pertinent data for the major wildlife species and summarize them chapter by chapter. Despite the poor organization and frequent inaccuracies, a lot of good information is crammed into these two volumes.

"The Way to Game Abundance" bu W. B. Grange, 1949. Chas Scribner's Sons. 383 pps., 24 pls. $3.00.

Grange restricts the greater part of his book to the relation of changing plant associations to the resulting impact upon animal populations. He attempts to link cycles of animal abundance to periodicity of weather which influences fire, the agent which produces productive wildlife habitat. An interesting chapter on controlled burning is presented. Material in this book would have little practical application to game management in British Columbia. However, it makes interesting reading and provides plenty of food for thought.

"Practice in Wildlife Conservation" by L. W. Wing, 1951. 422 pps., 58 illus. $5.50.

Wing presents a biological basis for management with a blend of scientific information and actual field practice. One reviewer states: "This book is a very good compendium of information and ideas in the fields of wildlife conservation, but it is not a complete coverage of the entire field nor is it the perfect text."

"Wildlife Refuges" by I. N. Gabrielson, 1943. The MacMillan Co. 270 pps., photos and maps. $5.50.

This book tells of the wildlife refuge system and its operation in the U.S.A. It describes the types, the purpose, and the management of the refuges as well as the refuges themselves. One chapter is

devoted to tabulation of wildlife refuges in Canada and Mexico. Apart from this and the few chapters dealing with general considerations in the application of the refuge system, the book's usefulness is rather restricted.

Monographs

Most of the more important wildlife species have been treated in a single volume by one or more authors. These are comprehensive works and anything that had been published at the time it was written is usually included.

North American Moose by R. L. Peterson, 1955. Univ. of Toronto Press. 291 pps., 66 figs., 35 tables. $12.50.

This book would be better titled "Moose of Ontario, with taxonomic section on North America." It is not as detailed as one would expect. The section on management is skimpy and rather weak. The section on moose aging is excellent but not worth $12.50 by itself.

The Elk of North America by O. J. Murie, 1951. The Stackpole Co. and Wildlife Management Inst. 376 pps., illus. $6.50.

In the book's Foreword, I. N. Gabrielson states: "Murie has produced an extremely significant and worth-while volume which will be useful to hunters, wildlife administrators, technicians, students and educators for many, many years." The work is thorough and covers every phase of elk biology, ecology and management.

The Deer of North America -- The White-Tailed, Mule and Black-Tailed Deer, Genus Odocoileus -- Their History and Management edited by W. P. Taylor, 1956. Stackpole Co. and Wildlife Management Inst. 685 pps., illus. $12.50.

"An encyclopedic book every wildlife library should have despite its price. Its 16 experienced authors discuss everything from reproductive cycle, nutritive needs, habitat management, life equation, habits, and taxonomy to hunting methods and care of meat."

The Pronghorn Antelope and its Management by A. S. Einarsen, 1948. Wildlife Mgt. Inst., Washington, D.C. 254 pps., illus. $4.50.

This book deals with all phases of antelope biology, ecology and management.

The North American Buffalo by F. Gilbert Roe. 1951. Univ. of Toronto Press. 965 pps. $12.00.

This impressive volume covers the taxonomy of the plains bison, climate and topography of the habitat, habits, destructive agencies other than man, discovery by Europeans, former range, numbers, migration and influence on the Indian's mentality.

The Puma, Mysterious American Cat by S. P. Young and E. A. Goldman. 1946. The Am. Wildlife Inst. 372 pps., illus. $4.00.

Young describes the history, life habits, economic status and control of the North American cougar, and Goldman concerns himself with the classification of its races. As in most of the monographs, the observations of many people are assembled in an orderly fashion. It is a good reference.

The Clever Coyote by S. P. Young and H. T. Jackson. 1951. The Stackpole Co. and Wildlife Management Inst. 426 pps., illus. $6.50.

The coyote book is presented in a manner similar to that of the cougar reference. A wealth of scattered information has been summarized in this book. Young spent the best part of his life studying the large predators of western United States.

The Wolves of North America by S. P. Young and E. A. Goldman. 1944. American Wildlife Management Inst. 656 pps., illus. $6.00.

The style of presentation is the same as that of "The Puma". Regardless of how much one might know about an animal in his own area, it is always interesting to compare the observations of those in other regions. Frequently, in doing so, we see the situation in an entirely different light and realize there have been certain things that have escaped us.

Wolves of Mount McKinley by A. Murie. 1944. U. S. Government, North America Fauna Series. 257 pps., illus. $1.00.

Although the title is somewhat misleading, this outstanding book is worth many times the dollar which will purchase it. Murie's studies in Alaska were primarily aimed at the Dall sheep and wolf populations in the park. However as might be expected, the entire animal community is related and he also covers the ecology of such species as the caribou, moose, and ptarmigan. Considerable work went into the detailed study of the relationship of disease and predation in the sheep population.

Wildlife in Alaska by A. S. Leopold and F. F. Darling. 1953. The Conservation Foundation. 129 pps., illus. $2.75.

Similar to "Wolves of Mount McKinley," "Wildlife in Alaska" is not a monograph, but deals in a very general way with all the major big game species in Alaska. It stresses the influence of human activity such as fire and settlement on the big game populations, and the need for a broad, far-reaching approach to the management of the big game resources. In many ways the circumstances in British Columbia are paralleled and much can be learned from this excellent book on big game.

North American Big Game by H. E. Anthony et al. 1939. Chas Scribner's Sons. 555 pps., illus. $10.00

Over two dozen authors contributed to this book and every big game species on the continent is considered. There are chapters on conservation, rating of trophies, care of trophies, horns and antlers, archery, photographing big game, and rifles and ammunition. In addition, there are chapters on the description, distribution and hunting of each game species.

Records of North American Big Game by the Boone and Crockett Club Committee. 1952. Chas. Scribner's Sons. 191 pps., illus. $6.00.

The authors of this book assess the ranking of trophies on a scientific basis designed to give weight to beautiful and symmetrical trophies rather than to freaks. This is an excellent reference for those who are frequently queried regarding big game heads. It describes fully the system for rating heads of the various species and provides a list of the record heads to the time it was published.

The Ring-Necked Pheasant and Its Management in North America edited by W. L. McAtee. 1945. The Am. Wildlife Inst. 320 pps., illus. $3.50.

Seventeen authorities have contributed to this book, and it covers the entire field of pheasant biology, ecology and management on all parts of the contient.

Pheasants Afield by D. L. Allen. 1953. The Stackpole Co. 128 pps., illus. $1.00.

Anyone interested in pheasants will be interested in this account of habits and management of pheasants in North America. It has the easy-to-read style which the same author uses in "Our Wildlife Legacy". The information in the book is carefully screened and contains pertinent facts revealed by up-to-date studies.

Pheasants of North America edited by D. L. Allen. 1956. Wildlife Management Inst., 508 pps., illus. $7.50.

This book is the sequel to McAtee's "The Ring-necked Pheasant and Its Management in North America." For the game manager or administrator who has pheasant problems it is a ready reference and compilation of the knowledge up to about 1951. Considerable information contained in this book has heretofore not been published.

The Ruffed Grouse - Its Life Story, Ecology and Management by F. C. Edminster. 1947. The MacMillan Co. 411 pps., illus. $1.95.

For the current cost, this is a good reference. As the title implies, it covers a wide range of topics dealing with the ruffed grouse. Emphasis has been placed on eastern grouse populations.

The Ruffed Grouse by Gardiner Bump, et al. 1947. New York State Conservation Dept. 915 pps., illus. $11.00.

This large volume on the ruffed grouse is the result of many years of research and compilation of all available information on the biology and management of the species. It is a book for the specialist and not recommended for the average man's reading.

The Sage Grouse in Wyoming by H. L. Patterson. 1952. Sage Books Inc. 365 pps., illus. $5.00.

Patterson has made a comprehensive presentation of the known facts about sage grouse and its management. Emphasis is placed on land use activities as related to grouse abundance, distribution, productivity and management.

American Game Birds by F. C. Edminster. 1954. Chas Scribner's Sons. 510 pps., illus. $12.50.

One reviewer has stated: "This volume presents a well organized cross-section perspective of seventeen species of upland game birds, of which three are exotics -- Hungarian and Chukar partridges and ring-necked pheasant." For each species, all phases dealing with the history, biology, ecology and management are discussed. Land use influences are stressed throughout.

Selected List of Waterfowl References

The Ducks, Geese and Swans of North America by F. H. Kortright. 1943. The Wildlife Management Inst. 483 pps., illus. $6.50.

This book has been mentioned earlier in the Handbook. The colored plates of paintings by artist T. M. Shortt alone justify the cost of the book. These excellent illustrations portray all the changing plumages of the ducks, geese and swans, from the downy ducklings on. The fall and juvenile plumages are of special interest because that is when most of us have the opportunity to examine birds close at hand. No less useful or competent are the discussions on the species' habits, distribution and migrations.

The Canvasback on a Prairie Marsh by A. H. Hochbaum. 1944. American Wildlife Inst., 201 pps., illus. $3.00.

This is one of the finest books ever written on ducks. Its title is rather misleading because it is not devoted to any single species. The author covers topics ranging from courtship of ducks to management and bases his writings upon personal experiences and study at the Delta Research station in Manitoba. The style is easy to understand and pleasant to read.

Prairie Ducks. A Study of Their Behaviour, Ecology and Management by L. K. Sowls. 1955. The Stackpole Co. 193 pps., illus. $4.75.

This is an excellent waterfowl book and presents considerable detailed basic information on duck ecology, so necessary for sound management. The author concerns himself with mallards, pintail, shovellers, gadwalls, and blue-winged teal.

Travels and Traditions of Waterfowl by A. H. Hochbaum. 1955. The Univ. of Minn. Press. 313 pps., illus. $5.00.

In the same manner as in "The Canvasback on a Prairie Marsh" Hochbaum has made an outstanding success in the presentation of his observations and conclusions. This book deals with movements of ducks, both local and distant, and represents an excellent contribution toward the understanding of waterfowl migrations and ecology.

North American Waterfowl by A. M. Day. 1949. Stackpole and Heck. 349 pps., illus. $4.75.

"North American Waterfowl" has a broad approach to the waterfowl problems of the continent. There are chapters on the history of waterfowl, protective legislation, bird migration and the flyway concept, the refuge system and other management problems. One chapter deals with waterfowl conservation in Canada.

Miscellaneous Publications

Conservation Law and Administration by W. F. Schulz. 1953. The Ronald Press Co. 607 pps. $10.00

"The volume under review lays bare for public scrutiny the conservation law and administration in one state, Pennsylvania ..... There is much in this discussion of Pennsylvania which is applicable in other areas."

"The book includes four long chapters on wildlife matters, three on water, three on forestry, and one each on soil conservation, recreation, 'legal devices', and 'A Model Act for Conservation Administration'".

"Certainly the best book of its kind published in America, it deserves a wide audience."

Proceedings of the North American Wildlife Conferences. $2.50 per volume.

These proceedings, published annually by the Wildlife Management Institute, represent a collection of papers dealing with a wide range of wildlife subjects. The papers are presented at the conference. Some are general and philosophical in nature, others are technical. A single volume may contain as many as 600 pages.

Technical Periodicals

The Journal of Wildlife Management published by the Wildlife Society.

Membership costs $6.00 per annum and includes a subscription to the Journal which is published four times a year. An average of 13 technical papers dealing with wildlife is included in each issue. In addition there are usually a number of briefer articles and book reviews.

California Fish and Game published by the State of California Department of Fish and Game four times yearly.

The subscription rate is $2.00 per year. Each issue contains up to approximately six technical articles on fish (including marine fishes) and game of the California region. Briefer notes and book reviews may also be found in each publication.

Non-technical Periodicals

Almost every state and provincial game and fish department publishes some type of non-technical periodical, primarily as a public relations function. Although they are usually prepared for "resident" consumption, there is considerable material that is of interest to anyone concerned with conservation. It is a good idea to keep in touch with what is going on outside our borders so that our thinking does not become too narrow and stagnated. The following list of bulletins are published throughout most of the west.

Wildlife Review (British Columbia) published by the British Columbia Game Commission, 567 Burrard St., Vancouver 1, B. C. Quarterly, free.

Wyoming Wildlife published by the Wyoming Game and Fish Commission, Box 378, Cheyenne, Wyoming. Monthly, $1.00 per year. This is one of the best non-technical periodicals on wildlife put out.

Colorado Outdoors published by the State of Colorado, Department of Game and Fish, 1530 Sherman Street, Denver 1, Colorado. Monthly, $1.00 per year. Along with "Wyoming Wildlife" this periodical leads those put out by most of the other western states.

Nevada Fish and Game published by the Nevada Fish and Game Commission, Reno, Nevada. Quarterly, free.

Montana Wildlife published by the Montana Fish and Game Department, Helena, Montana. Quarterly, free.

North Dakota Outdoors published by the North Dakota State Game and Fish Department, Bismark, North Dakota. Monthly, $.50 per year.

Idaho Wildlife Review published by the Idaho Fish and Game Department, 518 Front Street, Boise, Idaho. Bi-monthly, $1.00 per year.

Oregon State Game Commission Bulletin published by the Oregon State Game Commission, 1634 S. W. Alder St., P. O. Box 4136, Portland 8, Oregon. Monthly, free.

Fish and Game Bulletin (Utah) published by the Utah State Department of Fish and Game, 1596 West North Temple, Salt Lake City, Utah. Monthly, $1.00 per year.

Wisconsin Conservation Bulletin published by the Wisconsin Conservation Department, Madison 1, Wisconsin. Monthly, free.

Washington State Game Commission Bulletin published by the Washington State Game Commission, 509 Fairview Ave. North, Seattle 9, Washington. Quarterly, free.

Botany References for British Columbia

Trees, Shrubs and Flowers to Know in British Columbia by C. P. Lyons. 1952. J. M. Dent & Sons. 168 pps., illus. $3.25.

This is an excellent handbook and guide for the amateur botanist in British Columbia. The author uses artificial color keys for identifying flowers that can be readily used without a detailed knowledge of plant anatomy. The illustrations are also designed to aid identification.

Native Trees of Canada published by the Dep't of Mines and Resources, Mines, Forests, and Scientific Services Branch, Dominion Forest Service, Ottawa. 310 pps., illus. $1.50.

For each tree species in Canada, this book provides a description illustrating special characteristics, distribution and a note on the uses of the wood, etc. This book is a bargain !

The Grasses of British Columbia by W. A. Hubbard. Published by the Provincial Museum, Victoria. Handbook No. 9. $.50.

Hubbard's book describes every grass species found in the Province and provides keys for identification, using the anatomy of the plant for distinguishing characteristics. Included are excellent illustrations and information on distribution.

Where to Purchase Books

The wildlife books mentioned in this section are seldom stocked by book stores so usually have to be ordered. Few book stores in British Columbia provide good ordering services. The University Book Store is one exception, however its service is not convenient for those living out of Vancouver.

Of several book suppliers in the U.S.A., the Pierce Book Co., Winthrop, Iowa, has been found to be very reliable. For the most part, this company can offer a better deal than any Canadian book store. Each year it publishes an up-to-date catalogue on conservation books and pamphlets and sends it to everyone who wishes to be on their mailing list. This company frequently has books for sale which are out of print.