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By Hugh F. Travis and Philip J. Schaible

FUR ANIMAL PROJECT
Department of Poultry Science
Michigan State University

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FOREWORD

Ownership and operation of a mink ranch entail many problems. Beginners must have a working knowledge of elementary principles to avoid the hazards incidental to breeding and raising mink. Even experienced ranchers may be seriously handicapped by inadequate information.

This bulletin provides basic explanations of various phases of mink production. It is designed to be a practical and common sense guide through the maze of problems that confront new and smaller mink ranchers. It is not intended for the relatively few large-scale enterprises whose problems only professional specialists can be expected to handle.

I. INTRODUCTION

History and Development of Mink Ranching

MINK FUR HAS BEEN regarded highly from remote times—at first, for its usefulness, recently also for high-fashion finery. So it is only natural that enterprising farmers tried their hand at raising mink under domestic conditions. In the United States, a few mink were raised on farms almost a hundred years ago, but commercial-scale ranching goes back only a few decades. No other branch of animal husbandry has made such rapid and spectacular strides in so short a time. Fur farming today is concerned with mink* more than any other fur animal.

Before World War II, wild mink made up a high proportion of pelts marketed. These pelts varied widely because the animals differed in color, quality and size from one geographical area to another. Also, wild mink were frequently trapped before they were prime.

In contrast, modern mink ranching allows the harvest of fully prime pelts. Even more important, ranching permits controlled breeding and propagation of strains with desirable fur quality.

The original foundation stocks for ranch production in the United States were wild mink native to the Upper Yukon, Matanuska Valley and Kobuck districts of Alaska, and Quebec and Nova Scotia in Canada. Mink from Alaska were larger than those from Canada, but the Canadian strains had finer fur quality.

Mink now raised on ranches probably represent a mixture of all the sub-species of the North American mink because of the infusion of local mink into the ranchers' captive herd. The practice is still being carried on to a small degree. These so-called true mink *(Mustela vison)* are larger and more heavily furred than the "Jap" or wild mink *(M. itatsi)* native to Japan, which more nearly resemble weasels. The fur of North American wild mink is light brown, but the shade, density and fineness varies from one region to another.

In the early days, good animals were rare and very valuable. The 1920's saw a boom in mink ranching, and unscrupulous promoters

* Plural of the word "mink" is either "mink" or "minks"—with the former much easier to use.

took advantage of this demand by supplying inferior mink. As a consequence, many would-be ranchers lost their investments. Later the field was slowly developed by legitimate breeders.

Occasionally mink of odd or unusual colors have occurred. At first, these "freak" mink were considered a nuisance which interfered with breeding plans and the animals were disposed of as quickly as possible. These so-called "mutations" also occur in nature.

The first mutation to command much attention was the platinum (silverblu) which showed up on several mink ranches as early as 1931. This was an entirely new mink which pioneered later developments of valuable new color phases. Today, mink pelts are available in more colors than any other fur-bearing animal. Colors vary from white through various shades of grey, from silver tones to gun-metal, beige, light brown, blue and black. Light brown mutations, called pastels, resemble the color of North American wild mink. These new types have greatly increased United States consumption of mink skins through their influence on styling.

In the early days it was thought that mink must be raised under conditions close to nature and that they needed access to water. This led to the adoption of several systems of rearing. Under the "natural" plan, mink lived under natural conditions in a fenced-in range but were supplied supplemental food and nests. The animals had to be trapped. Under the "colony" plan, mink were raised in houses with runways to a source of water and were provided food and nests. These systems were reasonably satisfactory but frequent contacts between animals caused pelt quality to suffer. As a result, the present-day "pen" plan evolved which keeps each animal in a separate cage supplied with food, water and nest box.

Ranchers must skin the animals, remove the flesh from the skins and dry the pelts before shipping them to the auction houses. They are then called "raw" or "undressed" skins or pelts. Raw skins have to be tanned and "dressed" to prevent decay and to make them pliant and durable, suitable for manufacture into apparel. Most mink skins in the United States are used undyed.

The mink skins, however, are not always the most costly items in the retail price of a finished garment. Much craftsmanship is involved. Mink skins are not just sewn together, head-to-rump. They are "let-out". That is, pelts are cut into thin chevron-shaped strips which are sewn together so that the length is increased at the expense of

width. Let-out skins make a uniform, harmonious stripe all the way down the garment length. This craftsmanship creates greater beauty and has proved a boon to furriers. It adds greatly to the cost of a finished garment, which, however, is compensated by its increased value through added beauty and attractiveness.

A full-length mink coat requires 60 to 90 skins; three-quarter length coat about 40 skins; jacket, stole, cape or neckpiece from 2 to 40 skins. Mink fur is also used for collars, cuffs, pockets and in trimming coats, dresses and suits.

Production and Consumption

Ranch mink supply the bulk of present world consumption of mink skins. Commercial quantities of mink skins are produced only in the United States, Canada and northern Europe. Original breeding stock abroad came from the United States and Canada.

The National Board of Fur Farm Organizations reports statistics on United States mink production with respect to state produced, color phase and average pelt prices, as well as import and export figures. The National Board does not forecast the size of the new mink crop nor speculate as to market conditions.

In the United States, there are about 6,200 mink ranches concentrated mostly in the upper Midwest where there is a suitable climate as well as abundant supplies of fish from the Great Lakes and meat byproducts from the Midwest packing plants. Individual ranches may have from a few up to 10,000 female breeders, with one male breeder for every 4 to 7 female breeders. Since litters average 3 to 4 kits, the production of skins per ranch ranges from a few to 30,000 or more annually. Most ranchers increase their production by retaining kits from their own output for future breeders.

"Commercial" operations have at least 350 female breeders, producing 1,000 or more skins. About one-fifth of the United States ranches are in this classification. Most ranches have fewer than 1,000 female breeders; only about a dozen have more than 3,000. Of the 5,000 non-commercial ranches, 2,000 have fewer than 50 female breeders each.

Table 1 shows a 40-fold increase in United States ranch production and sales in the past two decades. In 1938 there were four times as many skins from wild mink as from ranch mink; by 1948, there were ten times as many skins from ranch mink as from wild mink.

TABLE 1—U. S. production, imports, exports and apparent U. S. consumption of undressed mink skins

Year	U.S. production			Imports	Exports	Apparent U.S. consumption
	Ranch	Wild	Total			
	thousands	*thousands*	*thousands*	*thousands*	*thousands*	*thousands*
1938	110	444	554	164	273	445
1948	1,526	741	2,267	646	252	2,661
1950	1,871	513	2,384	1,058	333	3,109
1951	1,967	639	2,606	865	343	3,128
1852	2,220	580	2,800	1,164	309	3,655
1953	2,483	538	3,021	1,269	334	3,956
1954	2,612	520	3,132	1,422	432	4,122
1955	2,912	455	3,367	1,657	437	4,587
1956	3,364	406	3,770	1,870	491	5,149
1957	4,417	349	4,766	2,763	785	6,744
1958	4,515	399	4,914	2,591	819	6,686
1959	5,078*	400*	5,478*	.....	...	.....

*Estimated.

Principal foreign markets for United States skins have been Canada and the United Kingdom. France, West Germany, Italy and Switzerland are becoming increasingly important. In recent years imports have been about half of domestic production—primarily from Sweden, Denmark, Norway and Finland. Thus, United States ranches supply about two-thirds of the domestic consumption of about 6.7 million skins. A substantial part of the imports are comparable in quality to domestic skins.

Undressed or raw mink furs and fur skins from most nations are duty-free; those from the Soviet Union and Communist China are prohibited. Imported dressed mink furs and fur skins are subject to an import duty of 7.5 percent of their value if not dyed; 10 percent if dyed.

Table 2 gives the breakdown by color of mink skins produced during 1958. It can be seen that pastels, sapphires and darks ran one, two, three respectively, in production.

The leading mink-producing states are shown in Table 3. In 1957, 1,450 ranches in Wisconsin produced 1.6 million skins or 35 percent of the United States output. Eighteen hundred ranches in Michigan,

TABLE 2—U. S. production for 1958 by color phase

Color phase	Number of mink	Percentage
	thousands	
Pastels	1,909	37.6
Sapphires	895	17.6
Darks	609	12.0
Gunmetal	433	8.5
Platinum	300	5.9
Pale brown	240	4.7
Pearl	197	3.9
White	130	2.6
Ruby-eye pastel	91	1.8
Winterblu	41	0.8
Lavender	40	0.8
Miscellaneous	192	3.8

Minnesota, Utah, Oregon and Illinois supplied thirty percent. Michigan was the third largest domestic mink-producing state in 1957, sixth in 1958.

TABLE 3—Top mink-producing states in 1958

	Number of kits produced in U.S.	Percentages
	thousands	
1. Wisconsin	1,700	33.5
2. Minnesota	463	9.1
3. Washington	316	6.2
4. Utah	274	5.4
5. Illinois	268	5.3
6. Michigan	246	4.8
7. New York	233	4.6
8. Oregon	208	4.1
9. Iowa	203	4.0
10. Ohio	175	3.4
11. Pennsylvania	173	3.4
12. Massachusetts	143	2.8
Subtotal	4,402	86.6
U.S. Total	5,078	100.0

II. PLANNING YOUR MINK OPERATION

Establishing a mink ranch is costly—in time, money, animals and equipment. Successful mink operations are based on a combination of good stock, good rations, good management and good markets. The beginner would be wise to seek all the aid and advice he can get, so as to avoid mistakes. Your neighbor mink ranchers are valuable sources of help because they have gained experience and knowledge in actually solving the practical problems you will face. Their knowledge of successful ranch operations will help protect you from costly errors.

You will need some knowledge in a number of fields that are important in mink production. *Genetics* or *heredity* of the animals determines maximum size, fur quality and reproductive performance; but other factors have to be favorable to realize the maximum from the animal's inborn potentials. *Foods* must supply all the nutrients that mink need at different seasons, as well as during different phases, of their life cycle. *Housing* is important to protect the color and texture of fur from damage by weather. Ranchers need to obtain good crops of kits year after year; thus, a knowledge of the *physiology of reproduction* is valuable.

If growth, reproduction or pelt quality is inferior, the rancher must find out if it is due to shortcomings in genetics—such as inbreeding or poor hereditary background; or to housing—as influenced by improper design and climatic variabilities; or to nutrition—brought on by nutritional deficiencies in the ration or by poorly or improperly processed raw ingredients; or to physiology—as affected by temperature or the amount of light. Mink ranchers do not have to be expert in all of these fields but they should know enough about them so that they can get information on the subjects from reliable sources. In general, ranchers will use their time more advantageously by concentrating on the husbandry aspects of production and not attempt to be their own nutritionist, geneticist, and veterinarian. However, they should be aware of the services of these specialists.

Marketing of mink pelts is competitive. There has always been a

satisfactory market for high quality pelts. When the market weakens, inefficient ranches and producers of lower quality pelts usually suffer the most.

Some states require licenses for raising mink and ranching may come under the jurisdiction of their Conservation Departments. Michigan does not require licenses. It classifies mink as domestic animals, along with cows, chickens, etc. which come under the Michigan Department of Agriculture.

The Fur Animal Project at Michigan State University will gladly provide suggestions and advice based on experience in serving ranchers having both small and large operations.

Opportunities

Mink ranching is a substantial industry which attracts the more capable agriculturists as well as wildlife enthusiasts. It does not compete seriously with other types of farming, and frequently is a sideline to another occupation. Land of little or no value for other crops can be used.

Opportunities for a livelihood in raising mink compare favorably with other livestock fields. It does not yield quick riches but can be profitable if pursued conscientiously and intelligently. The fairly large number of ranchers who have been in business for several decades attests to this fact. Mink ranching involves a substantial degree of risk, compensated by high returns for those who master its problems. An over-supply of pelts could adversely affect the market as could a style change in which mink becomes unfashionable.

Some ranchers specialize in raising mink for sale as breeders but most are in the business of producing skins and select their breeders from their own output. Full-time ranchers who are good managers and have good stock usually do well. Those who ranch part-time cannot let their other work interfere with their mink enterprise. Those who do a slovenly job, whether full or part-time, are less successful. In recent years, substantial ranchers have been well rewarded.

In addition to ranching, other positions in the mink industry require trained people. Many sell feed, equipment, drugs, biologicals, etc. to service the rancher. Others grade the animals and pelts, do research in genetics, nutrition and disease, or assist in marketing and promotion. The industry is rapidly becoming more technical in its various operations, and thus more highly skilled personnel have an edge over the untrained.

Mink is highly prized by women who want the best both in style and durability. Even those less well-off financially can acquire mink in some form, even if it be an accessory rather than a coat, scarf or stole. For this reason, it is unlikely that the market for quality mink fur will be saturated in the near future. When the market is down, it brings within reach new groups of individuals who previously had the desire but not the funds to purchase mink.

Mink ranching is not an in-and-out type of operation—as is true of most livestock operations. It should only be entered on a long-term basis. Weak markets in some seasons can thus be off-set by stronger markets in other years.

What it Takes

Several attributes are necessary for success in raising mink. First and foremost is a liking, respect and compassion for living creatures. If you do not truly have a feeling for, and a desire to work with, animals, it is useless to start in the mink business—you will not succeed.

Then, you must have substantial capital or financial backing. While many ranchers start on a small investment and a large amount of enthusiasm, they face an uphill struggle. Some ranchers have started with a few hundred dollars and gradually developed a full-time enterprise, but most of them have failed because of lack of funds to carry through to success. Capital investment in buildings, equipment, pens, animals and refrigeration required to support a farm family is from $40,000 to $60,000 in 1960 dollars.

The potential mink rancher must realize that he is entering a field of rather high risk, both in the raising and marketing of his product. Mink, like all other livestock, are susceptible to loss by disease, accidents in handling, etc. Also the kind of fur demanded is subject to the capriciousness of changing fashions. However, like most high-risk enterprises, when markets are good the return on investment is high; when they are bad, prices may fall below the cost of production.

The rancher must be healthy, strong and active. There is a lot of lifting, moving, carrying, etc. in preparing the daily food, feeding and watering, building cages, repairing sheds, catching and moving animals, etc. There is much outdoor work. The rancher must work rain or shine, cold or warm, snow or wind. He must keep mink on his mind constantly to make certain his valuable animals reach the

pelting stage in good condition. Disease could show up suddenly, and cause great losses unless swiftly combatted, whether day or night. Ranching is no clock-punching job. The animals must be cared for 24 hours a day, 7 days a week, 52 weeks a year.

Since most ranches are family affairs, the wife usually takes a very active part. To be a real helpmate, she must not be squeamish about animals, must like the outdoors, be willing to help keep the animals comfortable and the ranch running smoothly. It is said that one doesn't have to go to the ranch to see if it is well run—just meet the owner's wife!

Mink are difficult to handle and restrain. Despite many generations of domestication, they remain savage. They gladly bite the hand that feeds them. They also have a musky odor which is nauseating to newcomers who get a close whiff. The rancher's family should not complain about this.

Though scoundrels, mink rate high in the eyes of women as badges of social prestige. As long as they stay in the top spot in the fur business, raising mink will continue to attract enterprising individuals, and some will succeed.

Selecting the Site

Cool falls and moderate summers are ideal for developing quality fur and valuable pelts. Cold winters are not a problem but fluctuating cold and hot weather cause difficulty during whelping (when young are being born). Consequently, practically all U. S. mink ranches are located either in the Northern part of the country or in areas of high altitude. Nearness to larger bodies of water helps to moderate summer temperatures and thus helps avoid the possibility of heat prostration.

Mink do not need water to swim in nor do they have to be raised in the wilderness. Gently sloping land is best for a ranch but ranching is practiced on any type of land. Poor farming land is satisfactory. Light soils are preferable for good drainage. When selecting the site, keep in mind the possibility of future expansion. Some protection from strong winds, deep snow and direct sun is advantageous. A windbreak and some scattered trees on the enclosure are desirable if sheds or cage roofs are not used. Easy availability of low-cost supplies of meat and fish, which make up most of the mink ration, is a most important consideration in locating the ranch. It is an asset

to be on a road that will be open in all weather so that feed and supplies can be easily obtained. However, do not locate close to towns, villages or congested areas because of possible complaints on account of odor. A good and plentiful water supply for watering the mink, preparing food, and cleaning utensils is absolutely necessary, as is electricity for light, power and refrigeration.

From the point of view of climate, food supplies and accessibility, Michigan's Upper and Lower peninsulas and the Great Lakes area, in general, make ideal sites for mink ranching.

Investment, Credit, Income

Most mink ranches are owner-operated with members of the family performing most of the work. Some ranches are partnerships. A few are corporations. Larger ranches employ full-time workers and nearly all hire part-time helpers during the breeding and pelting periods. Mink operations require constant attention and therefore are not usually combined with other farm enterprises.

Labor is a substantial part of the cost of raising mink. The average number of workers employed in 1958 on ranches representing about one-third of United States production were 2.5 full-time, and 5 part-time workers who received cash wages plus 0.8 full-time and 0.8 part-time family members who did not receive wages.

Some idea of the amount of credit needed can be obtained by examining the capital needed for a one-man (plus family) modern ranch with a herd of 350 female breeders supporting a production of 1,400 pelts. Minimum costs for mink breeders are $50, cages $6, sheds $1 to $2 per animal, feeding and pelting equipment $2 per animal. For such an enterprise as much as $60,000 or more may be invested in ranch, residence, animals, refrigeration and other equipment. In addition, about $10,500 during the year will be required for food.

A 1958 survey of 501 ranchers showed that average expenses per kit were: feed $7.50 (43%), labor $3.50 (20%), depreciation and repairs $2.50 (14%) and all other $4 (23%); so it takes substantial working capital even after the ranch is established. Gross returns were $65,000, expenses $52,000, net returns $13,500. Thus, it is evident that substantial outlays are necessary to finance a sizeable mink operation.

To get capital, most ranchers, particularly beginners, rely heavily

on credit. The rancher borrows the difference between the purchase price and the down payment, giving a mortgage as security. Commercial banks, insurance companies, private individuals, National Farm Loan Associations and Production Credit Associations make real estate or mortgage loans.

After the beginner has title to the ranch and equipment, he acquires animals, food and supplies by short-term loans payable when the pelts are sold. Sources of short-term credit are the auction, food and supply companies, Production Credit Associations and commercial banks. To get a loan, the rancher outlines how much credit he will need, explains when and how he can repay the loan, and supplies a financial statement of what he owns and owes. Normally, security required is a first lien on mink and equipment but some loans are made without chattel security. The lending agency places great emphasis on the repayment potential of the ranch.

Wise use of credit is regarded as a tool vital to successful operation. Practically all mink ranches use credit to some degree. Even those well established may use credit due to the cyclic nature of the crop as well as to expand operations for increased efficiency. An efficient ranch operation should be big enough to fully utilize available labor and management ability so as to yield a satisfactory income for those supplying the labor and management.

Income from ranching varies with the size of the enterprise, the quality of the job done, the supply and current prices for the type of pelts produced. Average prices of mink skins (undressed basis) auctioned in New York City from 1954 to 1958 ranged from $19 to $25. Prices vary widely with color phase and quality from year-to-year as well as for a particular marketing period. A small offering of a new-type skin when first marketed brings much higher prices than when larger quantities are offered in competition with newer color phases. There is practically no carry-over or year-end inventories of mink skins at the ranch.

In considering the interrelationships of income and capital investment to expansion, the beginning small rancher should be aware of two critical periods as he enlarges his operation from a part-time to a full-time business. The first is reached when he has between one and two hundred females and is still working full-time at another job. At this point, he does not have the time to care for the animals and still work at an outside job—yet, the income from the mink alone is

insufficient to support his family. Thus he must either find sufficient capital to expand to a full-time operation, or he must take a sharp reduction in income for a few years. Sometimes this problem can be met if other members of the family find other employment or assume responsibility for the animals.

The second critical period is less crucial but does pose a problem for many ranchers. At this stage the rancher has 300 to 400 breeders and has decided that he would like some responsible help so that he can take an occasional hunting trip or vacation. Here again, there is the problem of capital investment—to have enough more mink so that the income will pay the salary of the helper. An estimated capital outlay of $10,000 to $40,000 is needed for each new employee, depending on the necessity for expansion of facilities other than pens and sheds and whether breeding stock must be purchased or may be obtained by enlarging your own herd.

These points should be considered by anyone who is planning to start with limited numbers of animals or limited capital. They are not insurmountable but the beginner should be aware of them and of the problems which they present.

Record Keeping

Record keeping is as important to mink ranching as it is to any successful business. Yet it is sometimes neglected due to pressures of day-to-day operations. Records need not be complex—in fact, the simpler, the better—but they must be accurate and up-to-date so that you will always know just where you stand.

Facts concerning feeding, whelping, production and pelt quality for each breeder help the rancher discover superior families and strains. It is on these facts that young breeders and those from the last season are selected in the fall.

Expenses for feed, labor, inventories and overhead determine the production cost of pelts; you need to know these expenses to figure the return on the investment. Thus accurate record keeping helps to keep the mink farm on a paying basis and to tell whether to expand or reduce production. The better and more profitable mink ranches control their operations by careful bookkeeping. Where ranchers have profit problems, inadequate records are frequently involved.

To show how simple and easy it is to figure food costs from your records at any given time, use Table 4. In the first column list your

TABLE 4—Methods for calculating food costs on "as is" and "as fed" bases

(1) Ingredient	(2) Percent or lbs.	(3) Cost per pound	(4) Cost per ingredient
Horsemeat			
Meat byproducts			
Poultry byproducts			
Fish			
Tripe			
Liver			
Cereal			
Etc.			
Totals "as is" basis	(A)		(B)
Amount of water			
Totals "as fed" (wet) basis	(C)		(D)

ingredients; in the second, enter the amount of each constituent used in a batch; in the third column, fill in the costs per pound of the various ingredients. Multiply the figures in the second and third columns to get the costs of the separate ingredients and place the figures in the fourth column. Total the second and fourth columns. Divide the total pounds in a batch (second column) into the total cost (fourth column) or B/A to get the cost per pound of the food on an "as is" or "no-water-added" basis. To get this value on an "as-fed" (wet) basis, calculate in a similar manner the value D/C. For comparing costs of different feeds, obviously it is necessary to put them on the same basis.

A discussion of breeding, whelping and grading charts is found in Chapter VIII.

III. BUYING YOUR FOUNDATION HERD

Where to Buy

One of your most important decisions is what type of mink to buy and from whom to buy your breeding stock. Your decision often determines success or failure. There are no infallible guideposts to lead you to the best breeding stock for your needs or to the rancher who may have it.

A good standard for judging the quality of a rancher's breeding

stock is his average pelt price over a period of years. If you are seriously interested in purchasing breeding stock from a rancher, he should be willing to supply this information. Other valuable criteria are the top prices received for bundles at the public auctions and the consistent winning of prizes at mink shows. Average pelt prices are the best criterion, as they express the value of the whole herd. Quality of animals may vary considerably. This allows some ranchers to have prize winners and, on the average, still have mediocre animals.

Ask the auction companies and mink marketing associations for lists of their customers that have done well in their sales. These will help guide you to good breeding stock. Since most beginners have little idea of what characteristics are important in buying breeding stock, you will have to rely on the judgment of reliable experienced mink ranchers.

Selecting Mink for the Breeding Herd

The best way to learn what is desirable for breeding stock is to go where you can observe many mink of a known quality. Field days, live animal shows, and pelt sales at the auction houses are indispensable to your education as a fur farmer. Some of the characteristics to consider in buying breeding stock are as follows:

The mink should be from a large litter if a young animal, or have a good production record if an adult. They should be large, but not necessarily the largest mink available. The size of the pelt is important but quality comes first. Animals should be strong with large bones, thick full neck and a short tail. The head of males should be broad with wide eyes and a blunt nose.

Current market conditions determine whether a certain color is desirable. Lightness of color is preferred in most color phases. A bluish cast is generally desirable; a reddish or brown cast is to be avoided. The color should be uniform from the top to the bottom of the hair with no trace of a color bar or off-color tip. The underfur should be clear and a pleasing contrast to the guard fur. Frosting or white tips and white hairs are undesirable. Mottling or uneven distribution of color throughout the body should be avoided. There should be as little white on the underbody as possible.

Other fur qualities to consider in selecting breeders are texture, density, coverage, length and character.

Texture is related to the diameter of the guard hairs. Rub the

fur between the fingers. Fine textured fur feels smooth and soft to the touch and is preferred. Coarse textured fur feels harsh and less slippery. If the texture is too fine, the guard hairs lack strength to stand upright. This is a rarity.

Density refers to the numbers of hairs per unit of area in the underfur. A good way to judge density is to part the fur of the mink with a comb to determine how much skin shows in the gap.

Coverage refers to the amount of guard hair per unit area.

Character refers to the way the hair stands in the underfur. Hair should be straight and stand at a slight angle leaning toward the tail, and appear well groomed. If it is full of cross hairs, some lying down flat, kinked or crooked, the character is not good.

To evaluate character and density at the same time, rub the fur against the grain and then back, noticing how the fur returns to its original position. It should fall back evenly and smoothly. If it is too thin, it will lie in all directions after stroking. Evenness in the length of the guard hairs is very important. Also, they should not be too long in relation to the underfur. Guard hairs on a mink are about ¾-inch to 1-inch long. On a female, they should be approximately 5/16 of an inch longer than the underfur, and nearly ½-inch longer on a male.

Number Needed

How many mink should you buy? To have a uniform, high quality herd, there must be a fairly large number of mink of each strain (a strain is a group of mink from one source with similar physical characteristics). There are two principal reasons for this: (1) There must be enough to avoid excessive inbreeding; (2) there must also be enough to make an adequate selection of breeding stock. Thus, a relatively large number from the same strain is advantageous.

Considering these factors, it would appear that about 100 breeding females and 20 to 30 males of one genetic background would be the minimum number desirable. If this purchase is impossible financially, consider this alternative: buy a smaller number but in future years return to the same breeder for more mink of the same type. Thus you will be introducing mink of the same strain and quality of your herd.

Starting out with small numbers of a new strain and buying out-

standing males should be left to the very experienced breeder who has the knowledge and resources to experiment with developing new strains of mink. Although a few "show winners" may improve the quality of your herd, they may not necessarily transmit these desirable traits to your particular herd.

Cost of Breeding Stock

Breeding stock usually costs two to three times the pelt price. Potential mink ranchers should buy the best quality mink that they can obtain and afford. While a high price does not necessarily get you the best breeding stock, an abnormally low price indicates that you are not getting high quality animals. This is not the place to cut corners or skimp at the expense of quality.

Types of Mink

If the rancher follows the above advice, which we believe to be very critical to his success, then perhaps only two or three different strains of mink would be raised on ranches of under 500 females.

The beginning rancher should concentrate on producing good quality mink of the more stable strains. He should not be tempted by the high prices that initial offerings of new mutations bring, to shift to these new colors. The latter is for the rancher who can afford to spend the money and take the risks involved in introducing a new type mink. The beginner and smaller ranchers will receive more for their efforts and expenditures if they concentrate on raising good quality mink of basic colors, such as darks, pastels, Aleutians and sapphires.

Which genetic strain you should buy depends on many factors. There is no one best answer to this question. Current market value, potential market value, possible use to produce more desirable strains, prolificacy, and lack of defects are some of the factors to consider.

Market value is determined by the natural beauty and color of the pelt, relative scarcity, current fashion trends, supply in relation to demand, and general economic conditions. When new color phases are introduced, the initial offerings are usually very high-priced due to their scarcity. As more animals are raised, the price drops. Production and prices of certain color phases seem to go in cycles, depending on supply and demand. However, changes in fashion trends can alter this at any stage.

In deciding what stock to buy, physical characteristics must also be considered. For instance, certain types of white mink (Hedlund) are deaf, difficult to mate, and poor mothers. Some mink that contain the Aleutian gene are less hardy, shorter lived and less prolific than other mink. Lethal genes or infertile young make their appearance in certain crosses (Stewart and Breath of Spring).

In summary, the beginner should buy only from reputable sellers of breeding stock. He should buy a relatively large number of each well-developed strain that he intends to produce. He can expect to pay from two to three times the pelt price for his breeding stock. To make a sound purchase, he will have to depend much on the character of the seller.

IV. HOUSING AND EQUIPMENT

The essence of good ranch management is to produce the highest quality mink at the lowest possible cost per animal. To stay in business, American ranchers must compete successfully with foreign producers who have lower labor and feed costs. To do this they must translate their advantages of greater working capital, mechanical ingenuity and technological ability into lower production costs. One of the ways to do this is to use efficient equipment that will allow one man to care for more mink, thus cutting the unit cost of production.

Ranch equipment should be low cost, long lasting, easy to clean and maintain, and labor-saving. Pens and sheds should supply the most favorable environment for the animal. They should be designed for easy observation of the animals. Expensive equipment does not necessarily guarantee the best management practices. On the other hand, sometimes a slight increase in capital investment may return the increased initial cost many times over in reduced labor costs or increased welfare of the animal. With these thoughts in mind, consider the equipment and housing currently in use on American mink ranches.

Feed Room and Feed Handling Equipment

Feed room and refrigeration facilities are a significant portion of the total investment. The difference between efficiently and inefficiently designed feed room and equipment may be hundreds of dollars

a year in labor expense. In a one-man operation, it will be a factor in determining the number of mink you can raise. Here are several considerations for the rancher who is building a feed room, workshop and storage facilities:

Location of the feed room in relation to the mink is important to efficiency of day-to-day operations. The feed room is usually located either near the entrance or the middle of the yard. When planning where to put it, keep in mind the distance from the mink, the many daily trips from the feed room to the mink yards, and the need for accessibility of supply trucks to the freezing facilities. The size of the feed room is determined by the total number of mink and the source and type of feeds.

Future use of the facilities should be considered. If you are starting on a small scale, plan the facilities to serve well as you expand operations. Some ranchers design a feed room that can be enlarged by knocking out a wall, or expanding in a certain direction. This avoids much difficulty in expansion. The feed room should be constructed of materials that permit thorough hosing and scrubbing of the ceiling, walls and floor. Floors should slope to a large drain. A grease trap is necessary if a septic tank is used. Abundant hot water is a necessity for good sanitation.

The flow pattern of feed through the room should permit the gradual blending of raw ingredients into the finished, mixed feed with the least possible amount of lifting and labor. Consequently, the hogger (coarse chopper) should be located close to the freezer, the grinder near the hogger, and the mixer close to the exit to the mink yard. Some labor-saving devices are overhead or screw-type conveyors, roller racks and tubs on casters or wheels. Cereals are sometimes handled from a bulk storage bin via an overhead chute that empties over the mixer. With a container of known size suspended under the chute you can measure the amount desired.

Relative heights convenient for workmen are another factor. Successive operations should be lower to minimize lifting. Unloading areas should be the same height as the truck beds. If rollers are used, the feed room should be designed so that they are used to advantage.

Feed room equipment varies with the size and type of operation but usually includes a hogger, mixer, grinder and refrigeration. Hoggers are heavy duty machines that will slice and shred chunks of

frozen meat or portions of whole carcasses including the bone. Grinders reduce unfrozen meat to sizes that can be easily eaten by the mink. Mixers blend the meat, fish, liver, cereal and water into a homogeneous mass of hamburger-like consistency. It is in this consistency that it is fed to the mink. Conveyors, meat saws and scales may be used according to individual needs.

The choice of hoggers, grinders and mixers depends on the size of the ranch and the kind and form of the meat or fish. Some manufacturers specialize in machinery for the fur farmer. It is false economy, both in time and money, to buy mixing and grinding equipment that is too small or inadequate. In choosing the proper mixer and grinder keep in mind the possibility of future expansion.

Feed storage capacity varies greatly with the length of storage and the source of the feeds. Ranchers who store their own fish calculate on 50 to 75 pounds of freezer capacity per mink, whereas ranchers on a mixed feed route may need storage for only 5 to 10 pounds per mink, or in some cases none at all.

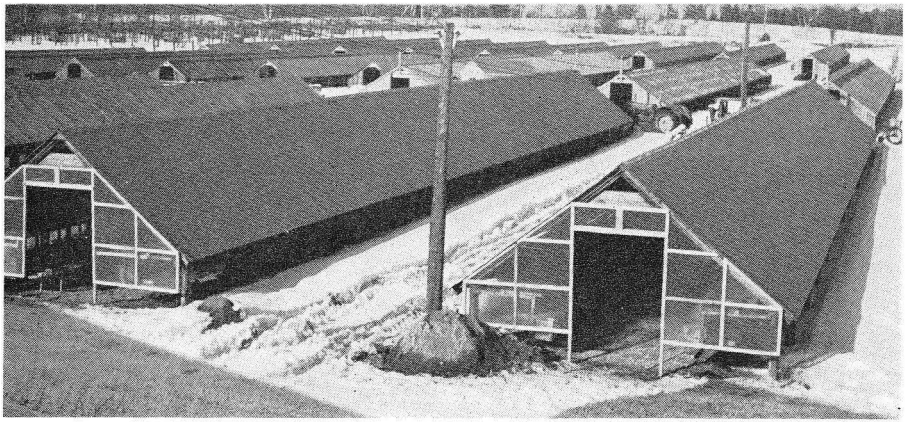
Refrigeration

There are three general types of refrigeration on the mink ranch: the *chill-room* (32° to 40° F.); the *frozen storage room* (0° or colder), and the *sharp freeze room* (−20° F. or colder, usually with a blower) where meat and fish are frozen. Ranchers who freeze their own food need all three types while those buying frozen food need only equipment for frozen storage and for storing chilled foods. Ranchers who get their food from co-ops or mixed food routes may need only chill room facilities. A good freezer arrangement can be best developed by the combined efforts of a good refrigeration man and someone who knows the problems peculiar to fur farming.

Sheds

Many ranchers raise good mink without sheds. However, it is the general belief among mink farmers that their several advantages justify the added expense and labor required to build them. Sheds do not by themselves guarantee optimum conditions for raising the animals. It is better to raise mink in well-designed outdoor pens than in poorly-designed sheds. Poorly designed sheds may create a poor environment for the mink.

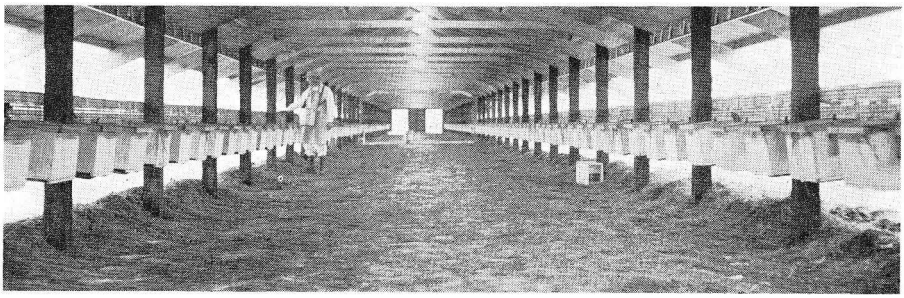
A disadvantage of sheds is their high initial cost. But they do have certain advantages. Labor costs are less as the animals re-



Sheds should be far enough apart to drive a tractor between them to remove droppings, and to keep snow from piling up and cutting off light in winter. Also they should be spaced so that the reflected light from one shed will not shine on the mink in another shed.

quire less bedding and watering. Snow removal is not a problem. Food costs are lower due to less food spoilage. The labor of feeding is reduced because food equipment can be moved more easily through the dry aisles. Initial cost of pens and nest boxes is less and their useful life is longer. It is easier on the rancher during the mating season and inclement weather. For these reasons it is generally more efficient to raise mink in sheds than in pens out-of-doors.

Rules for locating a shed are similar to those for locating outdoor pens. Sheds should be far enough apart so that snow cannot pile between them and block out the light during the winter. The roof from one shed should not reflect sunlight upon the pens of



Interior view of partially completed four-row shed. Note the cantilever construction of the overhang and the placing of nest boxes on the inside. Two center rows have not yet been installed.

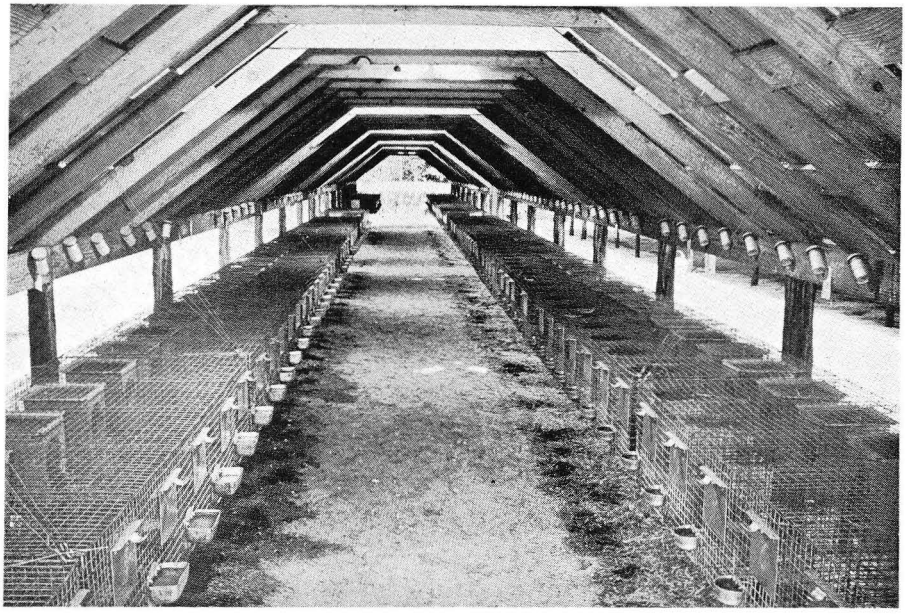
another shed (25 to 30 feet between sheds is sufficient). It is also wise to design them so that tractor-powered clean-up equipment can run between the sheds and power feeding equipment or hand carts can run within the sheds.

Most breeding sheds run north to south so that animals on both sides of the shed get about equal amounts of light necessary for normal reproduction. Caution should be used with electric lights in sheds. If the lights alter the length of day, mink may have difficulty priming in the fall or breeding at the proper time in the spring. Sheds should allow plenty of natural light to enter. One method of increasing the amount of natural light is to have roof sections of translucent fiber glass or plastic which will let in light without allowing the sun to shine directly on the animals.

Ventilation in sheds has not had adequate scientific study. Getting rid of moisture and foul air and controlling drafts in the winter and spring are practical problems dealt with by the rancher, sometimes to his disadvantage. In summer, properly designed sheds will be cooler than the surrounding atmosphere. Adequate air flow is necessary for the evaporation of moisture and to eliminate ammonia fumes from the droppings. Ammonia is believed to harm the pelts.

Most of the early mink sheds were the two-row type. To be more efficient and to lower construction costs, ranchers have increased the number of rows—often to 4, sometimes to 6 or 8 and occasionally to 16 rows. However, sheds with more than four rows do not seem to be so satisfactory.

Two row pelter shed.



Interior view of shed showing pens, feeders, water dishes, and nest boxes which set into the pens.

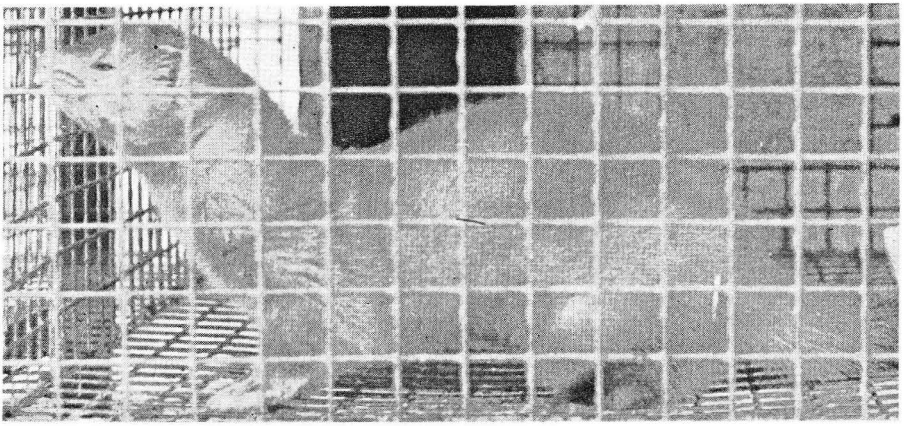
There are many different methods and combinations of methods for obtaining good ventilation. Some of them are as follows:

- Open sides on the sheds from 3 to 6 feet in height. The roof protects the pens from rain and snow but does not reach down far enough to keep air from entering from the sides. Some ranchers use translucent plastic that they can fold down along the sides during inclement weather.
- Commercial ventilators located at intervals along the roof line of the sheds.
- Split roof which allows air which has entered through the shed sides to come up and be expelled through the top and thus provide continuous ventilation.

Shed sizes vary with needs; they range in capacity from 50 up to over 8,000 mink. A typical shed would hold from two to three hundred mink. See the illustrations of breeding sheds, pelting sheds, and sheds to contain both breeders and pelter mink in the following pages.

Pens and Nest Boxes

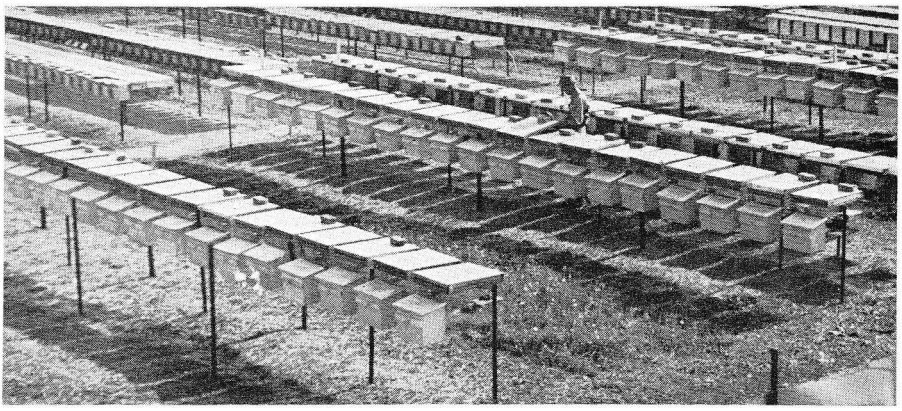
The method of construction of pens and nest boxes depends on whether they will be used outside or under sheds. Pens in sheds are usually in batteries; outside pens may be in batteries or of individual construction. Outside pens are usually covered by aluminum or tar paper painted with aluminum paint to protect the mink from the weather. The nest boxes of outside pens, particularly the covers, must be more substantial than boxes used in sheds.



Mink are kept in individual pens during most of the year so that they will not bite each other and damage the pelts.

The minimum size of pens which will give optimum growth and fur quality for mink is not known. The smaller it is, the more economical—but obviously this can be overdone from the point of view of animal welfare. Sizes given here are typical of those now in use. In constructing pens, sheds, and nest boxes—use standard widths to conserve labor and avoid waste of wire and lumber.

Breeder pens used both for breeder mink and the young until separation are somewhat larger than the pelter pens in which single mink are placed from weaning until pelting time. Breeder pens are usually from 30 to 48 inches long, 18 to 24 inches wide and 15 to 24 inches high. They are made from 1 × 1 or 1 × 1½-inch welded wire. Breeder pens should have a door on the top through which the false bottom of ¼ × ¼ or ⅓ × ⅓-inch mesh can be placed when the kits are young to keep them from falling through the

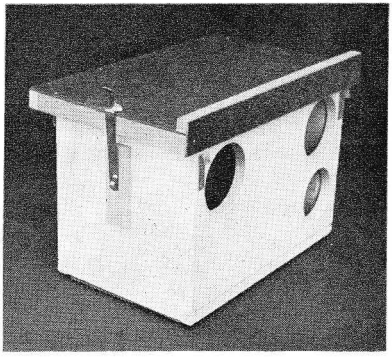


Portion of mink experimental ranch, Michigan State University, East Lansing

coarser wire. The door is also used for placing food on the feed tray and for cleaning.

The nest box of the breeder pen is placed at one end. Its purpose is to protect the mother during the winter and the mother and young during the late spring and summer until the kits are separated. Thus it must be designed to protect against cold and heat and, if outside, rain or snow.

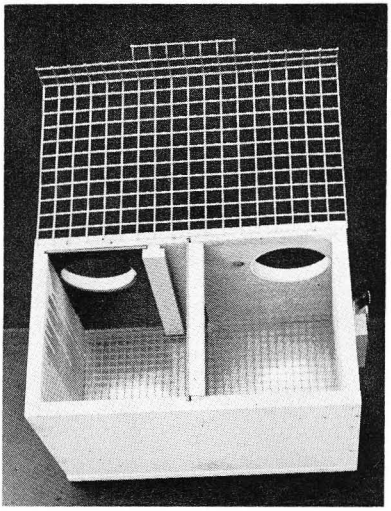
The typical nest box for breeding pens is 10 inches wide, 12 to 18 inches long, and 12 to 14 inches high. It should provide a warm, well ventilated area in the winter and a cool, well ventilated area in the summer. In winter it is important that enough air pass through the nest so that moisture in the mink's breath is carried out and not condensed in the nesting material. Holes drilled in the bottom or near the top along the backs and sides of the nest box can provide this ventilation.



Front view of new type nest box. The two upper holes are used when the nest box is divided to house two kits. The bottom hole is used when the nest box is adapted for whelping.

Furring pens, furring-out pens, pelting pens, or pelter pens as they are variously called, are usually smaller than breeder pens and generally built without a door. The opening to the pen is supplied by

the hole which provides the opening to the nest box. Pelter pens range in size from 12 × 12 × 24 inches up to 18 inches high, 14 to 18 inches wide and 30 to 36 inches long.

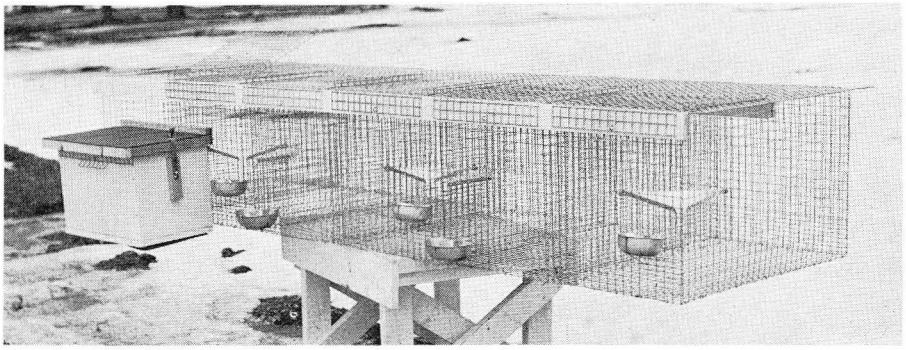


Top view of new type of nest box. It is ready for occupancy by two kits. By placing the removable center partition over the right hole and inverting the upper left panel, it is changed into a nest box suitable for whelping.

There is much more variation in the nest boxes for pelters than breeders. In general the former need not be as expensive or as complex as for breeders because they are not used in winter or when the kits are small.

Nest boxes for pelters may be placed in the pen or at one end. In recent years, there has been an increasing tendency to place the nests of pelter mink on top of the pens. This arrangement is more convenient when the mink are put in batteries in sheds. These "penthouse" nests are of several styles. One commonly used is a wooden box with a wire top. Often a wire trough is placed over the top of the nest and filled with hay. This permits the mink to pull the hay down to fill the nest box as it desires.

Another type which is frequently used is the "ring nester". In this nest, the resting area is 4 or 5 inches in diameter and 14 to 18 inches long. The hay is packed in an outer wire container which holds the bedding and surrounds the cylindrical nest. Another de-



New type nest box and pen showing attachment of nest box to pens.

velopment in bedding for pelter mink is the "hammock" nest, made of burlap which is slung from the top of the pen. Thus, there are many types of nests and all seem to permit satisfacory pelt production.

View of pens to which new type nest box is attached. Box attaches so that its openings coincide with openings in each of the two pens above.

Feeders and Waterers

Although it is necessary to feed each animal individually, mechanical aids are in use that greatly reduce the labor and shorten feeding time. The original and most primitive method is to walk around the yard carrying a pail and feeding with your hand or a large spoon or food gun. With the latter, food is sucked up by a plunger into the gun and then by pushing downward, it is released onto the feed board. On some ranches, overhead conveyor systems carry the feed in the sheds.

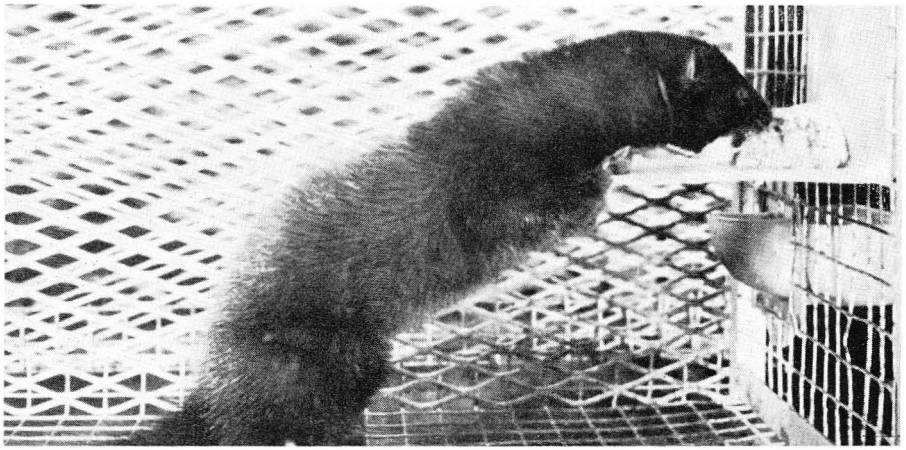
Feed carts can hold larger amounts of food than a man can carry, thus increasing his efficiency and ease of operation. They are manually operated or powered by gasoline motors so that the operator rides on them and feeds the mink as the cart passes through the aisles. Automatic feeders are powered carts with a hose-like

feeding mechanism attached so that the operator can put food on each pen by controlling a lever or button. Some automatic feeders permit the adjustment of the amount fed. In others, the quantity of food is pre-determined and each mink receives the same amount.

Feeding is a chore all ranchers share—yet there are wide differences in the efficiency with which they do the job. On small ranches, rate of feeding averages almost 500 mink per man hour for the main feeding during late summer after kit separation, using hand equipment such as buckets with harness, carts, track and trolley. Feeding by spoon or handfuls from pails is time-consuming because pails hold little and must be repeatedly refilled. Medium to large sized ranches feed almost 1,000 mink per man hour, usually employing power equipment. Very large ranches vary widely in the system, and consequently the speed, of feeding. Hand and power feeding are supplemented with carts to carry food from the feed room. The total feeding job is done in about two hours.

Feed boards vary with their intended use. In pelter pens they are elevated above the floor of the pen and are small so that the mink will not be tempted to lie on them and soil its fur. Feed boards in breeder pens are similar to those in pelter pens although often larger. Some ranchers do not use feed boards but feed on the wire of the top of the cage. When kits are from 3 to 8 or more weeks old, special feed boards are placed on the floor of the pen.

Left, feeding mink using a feed gun and manually-operated cart. Right, grinding fish for mink food.



Mink food is fed either on trays, as shown here, or placed upon the wire top of the pen so that the mink can pull it through.

These are usually flat pieces of metal or fiber board about 12 or 14 inches square, or low earthenware crocks.

Watering systems have been developed further than feeding systems. The sprinkling can is the most primitive method, followed by the hose attached to a faucet. Next comes the manually-operated mechanical system which has the advantages of permitting faster, easier filling. In this system, pipes are laid out so that there is a hole over each water dish. By opening a valve, water is turned on and each cup filled. This type of system can also be attached to a time clock so that the mink are watered automatically several times a day.

A recent development is an automatic watering system without watering cups. This system contains nipple valves sensitive to the touch of the mink. When the mink presses up on a valve, water is released. Water pipes can be kept thawed in winter by: (1) using electric heating cables and (2) draining the water from the pipes. Electric heating cables within the pipes of automatic watering systems have been used. There are also heating elements that fit into the individual cups. Due to the heating costs in Michigan these systems are too expensive for commercial ranchers.

Automatic systems are most valuable during the summer and early fall after the kits are separated from the mother. Perhaps the best method would be an automatic system which includes a cup so that mink could be watered by hand in freezing weather.

In deciding on which type of feeding and watering systems to install, you must consider such factors as available capital and labor, size of ranch and possible expansion. Another thing to consider is that mink need individual attention. *Every day* a competent person should observe *each mink* to determine if, it is eating properly, the bedding is satisfactory, and the animal is receiving sufficient water. Also, he should check the condition of the stool, fatness or leanness of the animal, and any irregularities in its health. A competent mink man can see these things at a glance but he must check every mink every day. Many ranchers do this during either the feeding or watering operation. But if the operation is automatic or so fast that individual observation cannot be made, time must be allowed for someone at some time during the day to make observations on the welfare of the animals. The equipment for raising mink may become automatic, but the care of the animals is still an individual procedure. These observations and catering to the differences between animals is often the difference between success and failure. Do not lose sight of this fact in the trend towards automation.

Pelting and Fleshing Equipment

Mechanization of the pelting and scraping procedures has been increasing steadily during the past few years. Equipment for manual skinning and scraping consists of a skinning knife, a scraper, a scraping board or beam, a stretching board and a pair of side-cutting pliers. The use of this equipment is discussed in Chapter VIII. A recently developed machine skins the mink more rapidly and with less effort than the manual method. It consists of a series of clamps and springs for holding the pelt while it is skinned plus a mechanical device to pull the pelt from the body.

Fleshing machines are also coming into popular use. More rapid and easier than the hand method, they mechanically scrape the excess fat from the skin. There are two types: (1) a mechanical hand fleshing tool which uses the same beam as the hand-operated method, and (2) the more complex, power fleshing machines which consist of a pole or beam over which the pelt is stretched. The pelt is fleshed by a vibrator unit attached to a blade which runs along a track parallel to the pole, gradually forcing the excess fat off the pelt.

Guard Fence

The guard fence is an indispensable part of mink ranching equipment. This wire fence encloses the area in which the animals are kept, and thus prevents escape of animals that get out of their pens. It also keeps out wild animals and pets, and thus helps prevent the spread of disease. Guard fences are usually 1 × 1 inch wire mesh 4 to 6 feet high, depending on the height of snow drifts. Bury them in the ground about 1½ feet, partly to prevent mink from escaping, but also to prevent rats and other animals from burrowing into the yard. The top of the fence has a baffle of sheet metal, often inclined inward at a 45° angle so that the mink cannot climb over the top of the fence.

Accessories

Other accessories in common use are gloves, catching cages, transfer cages, exhibition cages, nets and shipping crates. They are sold by fur farm supply houses, except for the shipping crates. Gloves, catching cages and nets are used in catching and examining mink. Transfer cages are small portable cages, usually built with several compartments, and used when mink are moved from one part of the yard to another. Their main use is for moving mink from the whelping cages where they were born to the pelter pens.

Exhibition cages, approximately 12 × 12 × 20 inches are used in mink shows. They are useful around the mink ranch, particularly for comparative grading of your mink.

Shipping crates are usually made by the rancher. These are used for shipping mink to shows or for the transfer of breeding stock. They are usually about 10 inches square and 2 feet long and may have several compartments. About half of each cage is enclosed in wood to form a nest-like area and the remainder is covered with wire mesh. Wooden partitions are used. Water dishes are included in each pen and the mink are fed on the wire in transit.

V. GENETICS

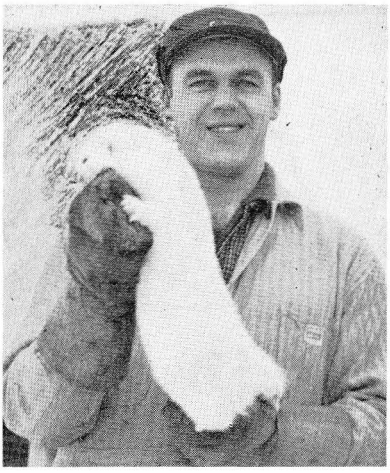
In the past major emphasis has been placed on determining the genetics of the color phases because these have been so profitable to ranchers. As a result, the different types of crosses which produce various colors are well known for all but some of the most

recently developed colors. The modes of inheritance of other traits, such as the size of litter, size of animal and fur quality, are less well known. Very likely more emphasis will be given these other traits in the near future. Progeny testing (evaluation of breeders by the quality of their young) has not been used extensively nor has artificial insemination of mink been developed into a practical procedure.

Some general principles applying to all color phase genetics are discussed here and examples of several types of crosses are presented. Genetic terms are avoided as much as possible. The terms used are defined at the end of this chapter.

Basic Principles

Let us start by discussing the basic principles by which animals propagate their kind. Bodies of all living organisms are composed of basic building blocks—individual *cells.* Each cell is composed of a *nucleus* surrounded by another type of material—*cytoplasm.* Cytoplasms differ, and this accounts for such dissimilar cells as nerve, muscle, fat, etc. Except for the reproductive cells, nuclei (plural of nucleus) of cells in different parts of the same animal are quite similar. Nuclei in mink body cells contain thirteen pairs of *chromosomes* plus one dissimilar pair which is concerned with sex determination. Each pair of chromosomes is different from the other pairs. Within the chromosomes are tiny units of *protoplasm*—the *genes*—which are distributed like beads on a string, and which determine the inheritance of the animal. There are hundreds, perhaps thousands, of these genes, each with its own special function and producing its own special effect, singly or in combination with others.



Large dominant white male breeder mink.

During body growth, new cells develop from portions of the living substances of other cells by division. During cell division, the pairs of chromosomes line up. Thus, chromosomes and their genes each have a partner.

In sexual reproduction, sperm and egg (ovum) fuse. These are the germ cells and are different from other cells in that there has been a splitting of the chromosome pairs so that each germ cell carries only one member of each pair of chromosomes. The union of the sperm and the egg (to form the *zygote*) results in the chromosomes again being paired. The resulting new individual thus obtains half of its inheritance from its mother and half from its father.

If both genes of a pair in a body cell are the same the animal will transmit this factor to all of its offspring and the animal is *homozygous* for this particular trait. An animal is said to be *heterozygous* when the genes in a pair are different. Each offspring has an equal chance of receiving one or the other of the different genes of this pair. Most animals are heterozygous for many sets of genes. Thus, even though two litter mates look alike it does not necessarily mean that the animals have the same genetic make-up.

Certain genes are called *dominant* because they mask or hide their *recessive* partners. Recessive genes do not show their characteristics unless both genes of the pair are present. The two alternate genes in a pair are called *alleles*. By the nature of the splitting when the germ cell is produced, only one of the alleles can appear from the parent cell. An analogy with the tossing of coins might be helpful here. When parent cells divide, it is as if one gene goes to each side of a coin. The two sides of the coin may be regarded as heads—*H* or tails—*h*, respectively, the two alternative genes of the pair. When we toss the coin, half of the time we would expect heads *H* and half the time, tails *h*.

If two coins are tossed independently, the probability of their falling the same way is the product of the chances of their falling either way separately—two heads would turn up on the average one-fourth of the time ($\frac{1}{2} \times \frac{1}{2}$ or $\frac{1}{4}$). Similarly, if we mate two mink that are each heterozygous for a gene *Hh*, we would average in four kits one *HH*, two *Hh* and one *hh*. These results follow the laws of probability or simple Mendelian inheritance. Note that we have qualified our statements with the phrase "on the average". If enough coins were tossed or enough kits produced, the ratios as stated would be true. However, as you well know, averages are not too meaningful for small numbers—of coins tossed or kits produced.

With this as a background, let us consider the genetics of some of the simpler types of crosses of mink to produce different colors.

Mutations are sudden changes in the hereditary factors or genes so that the offspring differ from its parents in some well-marked character (in our case—color), due to the changes of the gene from one form to a new form. A color mutation might occur, perhaps in one mink in a million. These mutations have been occurring as long as there have been mink.

Between 18 and 24 mutant genes are responsible for the hundred or so different combinations currently used for the commercial production of different colors in mink. Comprehensive references which discuss these interrelationships in detail are listed in Chapter XI. Mink of desirable color mutations are increased rapidly because breeding can be precisely controlled on fur farms.

Color differences are sometimes due to dissimilarities in only one pair of genes. Thus Aleutians and platinums differ from darks in being recessive in certain specific gene pairs for color. In fact, color can be altered by dissimilarities in only one member of a gene pair, i.e., Breath of Spring.

The genetic formula for a dark mink is:
PP II AA BB GG BgBg BiBi BaBa BsBs BmBm BpBp CC HH OO ff ss mm ee (capital letters represent dominant genes, small letters recessive genes). Mutant color phases differ from darks in one or more genes or gene pairs.

In order to represent the complete background of the mink, symbols would have to be devised for each gene and represented in its formula. However, in the interests of brevity, when writing the formula for a strain of a mink, we use only those symbols directly concerned with the genes being studied.

Simple Recessive

Now, let us discuss platinum or gray mink, the first color mutant that became commercially important and revolutionized the industry. What is said about the platinum applies to the breeding of any mink with a single pair of recessive genes. This includes the steel blu, imperial platinum, Aleutian, brown-eyed and green-eyed pastel, imperial pastel, socklot, ambergold, Moyle buff, palomino, and albino.

If you will observe Figure 1, you will see the results of crossing a homozygous dark *PP* with a platinum *pp*. The germ cells produced by the dark mink contain only the *P* characteristic. The germ cells from a platinum mink contain only the *p* characteristic. Thus, the only

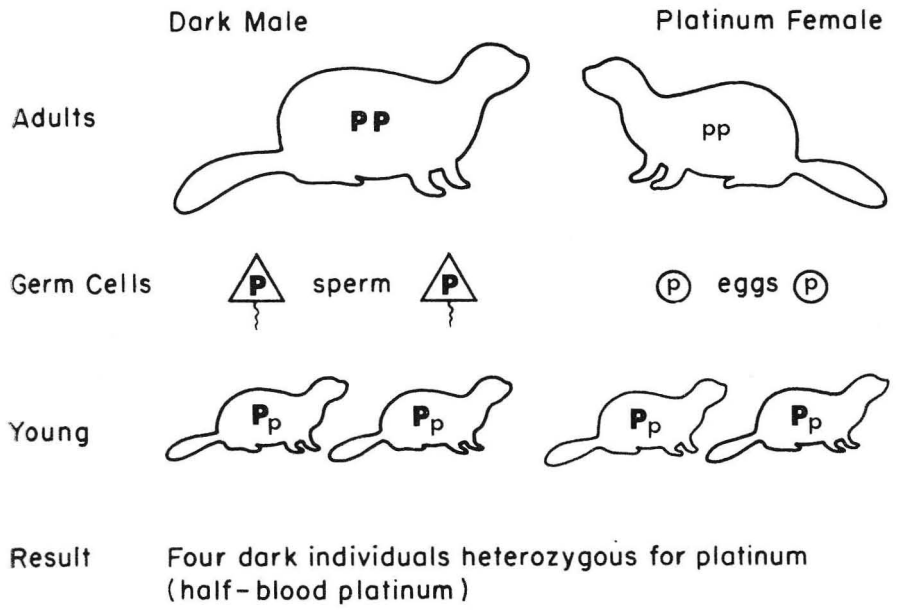


Fig. 1. Results of mating dark mink to platinum mink.

product of the mating can be zygotes which will develop into mink with the gene pair *Pp*. These will be dark mink heterozygous for platinum and will look like a dark mink although slightly lighter in color. Offspring of this color phase would be produced either from the mating of dark male *PP* × platinum female *pp* or from a platinum male *pp* × dark female *PP*.

Mink produced by these two parental crosses are called "half-blood platinums". Now, let us consider the mating of one of these first generation animals to a platinum (Figure 2). The heterozygous parent would be *Pp* and would form two kinds of sperm or eggs, as the case may be, having either *p* or *P* genes; whereas, the platinum parent would be *pp* and would form sperm or eggs having only *p* genes. Fifty percent of the young produced would be platinum and fifty percent would be dark mink (half-bloods for platinum). If these platinum mink were mated to other platinum mink, they would breed true and have platinum young.

The following more difficult material in smaller type may be skipped by those who do not have a serious interest in genetics.

Dominant

Now, let us consider the production of Breath of Spring or Stewart mink. It is generally believed that these colors are caused by the same gene. Stewart

platinums carry the color of platinum mink influenced by the Stewart factor. They are generally lighter than platinums, particularly in the underfur, with more ventral spotting and white guard hairs present. The Stewart factor designated by large case *F* is dominant and manifests itself if one gene is present. If two genes are present *FF*, the animal is very light in color and called a "homo" by the fur trade. "Homo" males will mate but are usually sterile. Some "homo" females have been reported to produce young. Figure III shows the results of the mating of a platinum male *ppff* to a Stewart platinum female *ppFf*. As the chart indicates, one-half of the offspring would be Stewart platinum and one-half platinum mink.

The results of mating two Stewart platinum mink is shown in Figure IV. This type of mating would produce one "homo", two Stewart platinums and one platinum, unmarked for Stewart.

Double Recessive

Many mink that are produced today are of the type called "double recessives". These are homozygous for two pairs of recessive genes. Mink produced in this manner include the sapphires, Eric, Finnish topaze, Heinen buff, pearl, regal white and several others. We will consider the crossing of the Aleutian with the platinum to produce sapphires, which are among the most popular of the double recessives. The mating of an Aleutian *aaPP* to a platinum *AApp* produces the sapphire in the second generation. In Figure V, the first generation results are shown for mating the Aleutian to a platinum. The offspring are heterozygous for both genes (dihybrids) and carry the genes *AaPp*. These mink resemble the dark mink in color.

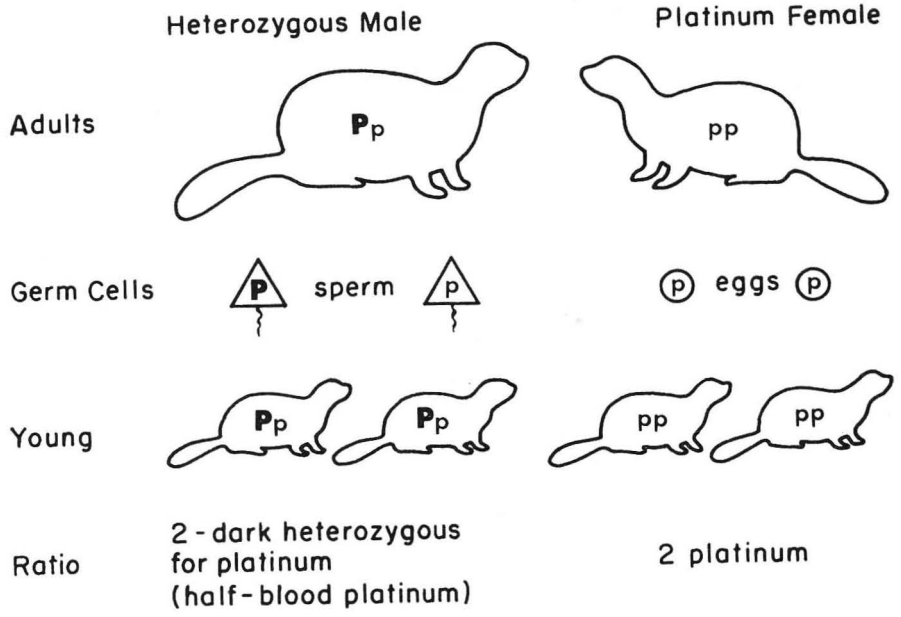


Fig. 2. Results of mating dark mink heterozygous for platinum with platinum mink.

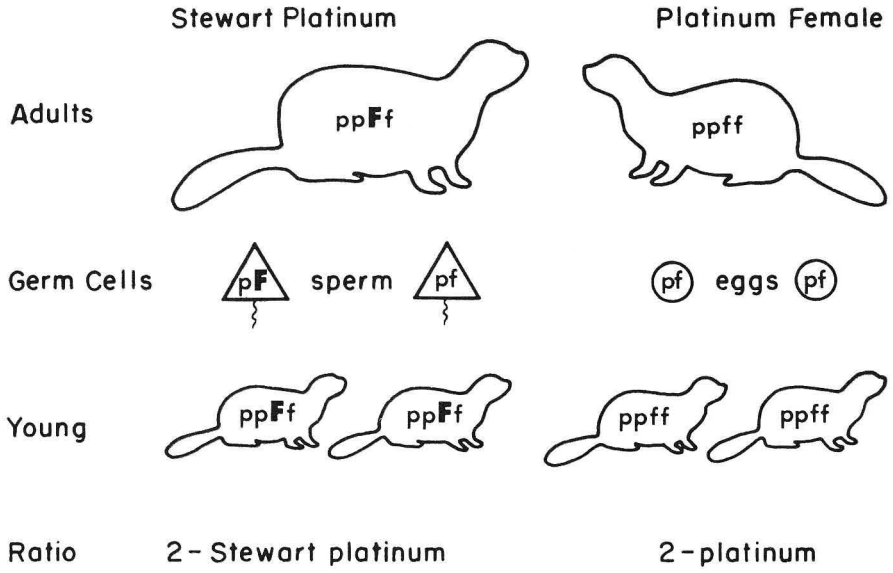


Fig. 3. Results of mating Stewart platinum to platinum.

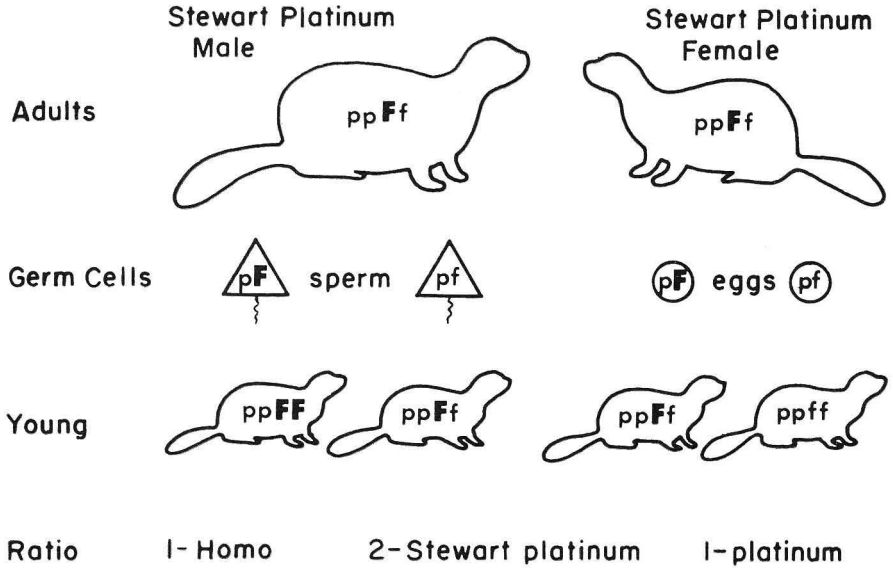


Fig. 4. Results of mating Stewart platinum to Stewart platinum.

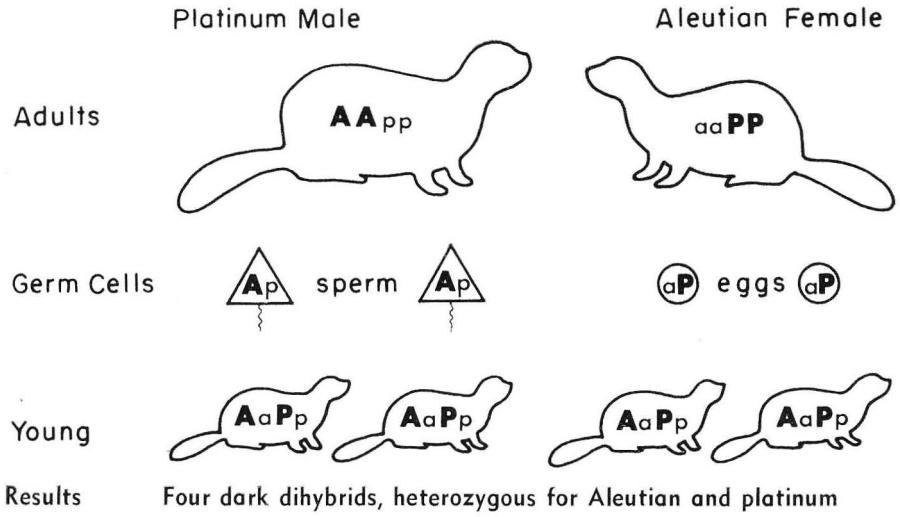


Fig. 5. Results of mating platinum to Aleutian.

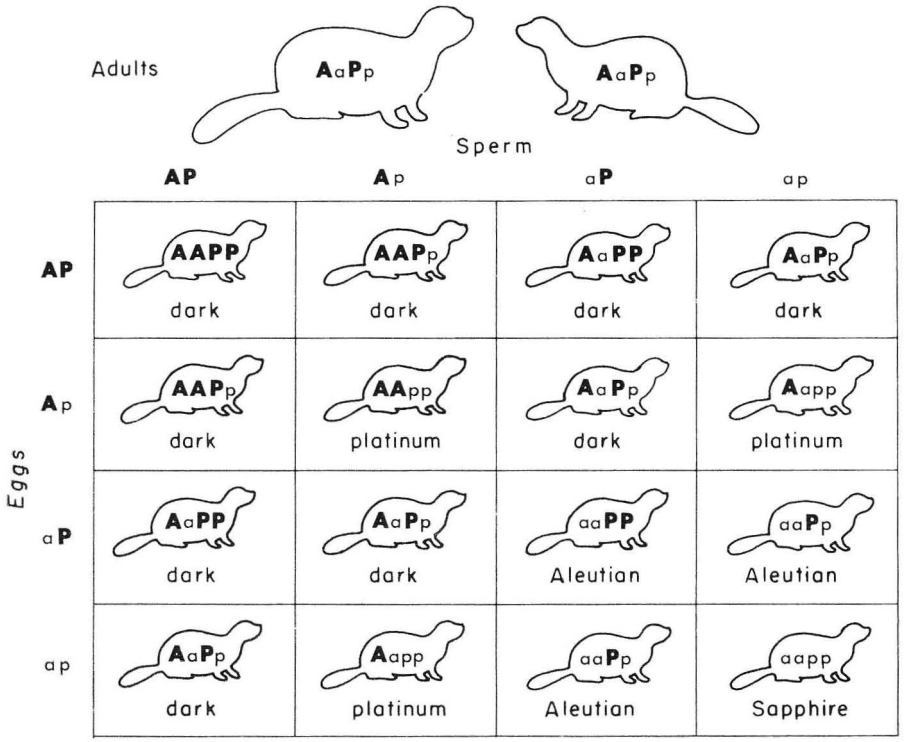


Fig. 6. Results of mating dihybrid (Aleutian and platinum) mink. Offspring obtained in a ratio of 9 darks, 3 Aleutians, 3 platinums and 1 sapphire.

In the mating of two dihybrid mink there are four possible kinds of sperm or eggs that can be produced *AP, Ap, aP, ap.* Thus, in the union of the sperm and the egg, two of the same type may be united, as can any of the 16 possible combinations. The results of such a mating are shown in Figure VI. Young are produced in a ratio of nine darks, three Aleutians, three platinums and one sapphire. Some of the darks will be heterozygous for Aleutian or platinum. Some of the Aleutians or platinums will be heterozygous for the other gene. The sapphires produced from this mating will breed true.

This preceding discussion is intended to explain the fundamentals of mink genetics and does not include much that is currently being practiced. However, if you grasp the above, you will have little trouble in understanding any color phase genetics. If you desire to learn about such things as triple recessive, double dominants, multiple alleles, and the various ways of producing white mink, you should refer to the references listed in Chapter XI.

DEFINITIONS OF GENETICS TERMS

Alleles	Different genes carried at the same place in the chromosome and affecting the same characteristic.
Characteristic	A trait, quality or property distinguishing an individual, group or type.
Chromosome	Bodies in the nucleus which contain genetic material.
Color phase	Variation from the wild or standard color.
Dihybrid	Heterozygous for two pairs of recessive genes.
Dominant	A trait that is manifested when a pair of genes is in a heterozygous condition, i.e. *Pp*, even though only one gene of the pair is of this type.
Egg (Ovum)	Female sex cell—contains one member of each pair of genes.
Gene	Basic unit of heredity.
Germ cell	Sperm or ovum.
Heterozygous	Each member of a pair of genes is different.
Homozygous	Both members of a pair of genes are identical.
Mutation (mutant)	Change of the genes from one form to another form so that the offspring differs from the parents in some well marked character.
Nucleus	Functional unit of the cell which contains the chromosome.
Recessive	Two genes of this type must be present for the trait to be manifested.
Sperm	Male sex cell—contains one member of each pair of genes.
Trait	A distinguishing quality or character; a characteristic or peculiarity.
Zygote	Result of union of sperm and ovum at fertilization.

VI. BIOLOGY OF THE MINK

Mink differ in many respects from other farm animals and a brief description of their biology will help explain "why we do, what we do, when we do it" in raising mink.

Minks are flesh-eating animals of the weasel family. This group includes other valuable fur bearers—weasel, marten, sable, otter, sea otter, wolverine, fisher, ferret, badger and skunk. In general, these animals have long slender bodies, short legs and short rounded ears. The mink has two scent glands located just within the anus. They are discharged when the animal believes itself in danger.

Wild mink are found near streams and lakes throughout the United States and Canada. Their food consists of fish, frogs, aquatic insects, snakes, small mammals and an occasional bird. Wild mink mate, whelp and prime at approximately the same times as those on commercial ranches. Both parents assist in bringing food to the young which stay with the adults until well into summer. Mink are most active at night although they may be seen occasionally in the daytime.

Wild mink vary in certain characteristics from region to region throughout their native range. The different types are known as sub-species and were discussed in relation to commercial fur farming in Chapter I.

Mink have certain peculiarities with respect to mating, reproduction, growth, pelt development, and the digestive tract. These are now discussed to show how they affect husbandry practices.

Mating and Reproduction

Mink have one breeding season a year. They mate during March, occasionally in late February or early April. The female shows no physical sign that she is in heat and the only way to tell is to let a male attempt a mating. Ovulation (the shedding of the eggs) is induced by the mating act, or on occasion by a sharp fight or rough handling when the ova (eggs) are in condition to be shed.

After the eggs are shed in ovulation, it takes 6 or 7 days for another set to develop which are capable of being fertilized. Eggs are shed from the ovary about 36 to 40 hours after mating and gradually work their way into the oviduct. At the same time the sperm works its way into the oviduct where it unites with the egg.

Gestation averages about 50 days, but may vary from 38 to 76 days. The vast majority would fall in a 40- to 60-day range. This variation occurs mainly due to "delayed implantation". After the eggs and sperm unite, they develop rapidly to a certain stage *(blastocyst)* and then stop growing. After a variable period of time they move downward and become attached to the walls of the uterus *(implantation)* and continue their development to full-term embryos. The period from implantation to birth is believed to be about 28 to 30 days. The implantation of the blastocysts is believed to be associated with an increasing length of day.

Several practical husbandry practices are based on knowledge of the reproduction cycle of mink. The first relates to the fact that ovulation is induced by mating or mating behavior. If a mating was attempted, but did not actually occur, and there was extensive scuffling or riding by the male so that the rancher believes the female may have ovulated, he has several alternatives: He can attempt a mating with another male on the same or the following day to fertilize the eggs already shed, or wait a week and give a new set of eggs a chance to ripen so that they may be shed in a new ovulation.

Because there is more than a day between the mating and fertilization, some ranchers use the system of mating on two consecutive days in the belief that this will make fresher sperm available than in the case of a single mating.

Some effects of delayed implantation can be put to practical application and others may have application in husbandry practices of the future. In general, the later in the season the female is mated, the shorter will be the gestation period; the shorter the gestation period, the larger are the litters. This does not apply to matings after approximately March 25. About twice as many eggs are shed as actually develop into live kits;—in other words, there is about a 50 percent mortality before the young are born. Most of this mortality occurs during the resting period before implantation.

Female mink can produce young by different males *(superfecundation)* and from two different ovulations more than a week apart *(superfetation)*. These account for occasional split litters. In a few experiments, the number of young was reported increased by this latter practice. Since most of the kits come from the second male if the matings are about a week apart, this fact can have practical

application in your breeding program. In other words, it would be advisable to use your better quality males for second matings.

Practical Breeding Program

From the above knowledge, what would be a practical breeding program? Probably the most efficient practice is to start matings about March 10, with about a fourth of the females being tried each day. In those females that are mated, an attempt should be made to re-mate on the seventh or eighth day. If the mink are not then mated, attempts may be made thereafter on alternate days.

Many ranchers believe that it is best to get as many matings as possible between March 18 and March 25. Because of this, if a first mating is achieved on March 18 or after, an attempt is made to mate the mink the next day but no attempt is made to re-mate seven days later, or after March 25. If mink mated after the 18th do not mate on the second day, try them between the 25th and 29th. If the females are vicious, discontinue your attempts on those already mated after about the 25th. Most ranchers discontinue attempts to mate their mink by April 1, except on certain late-mating strains.

The effects of light on the onset of the mating season in mink is another aspect of reproduction that has important implications to the practical rancher. Experiments have shown that the onset of the sexual cycle can be altered by varying the length of daylight that the animals receive. The breeding season is brought on by the increasing length of days. If the length of day is increased by the use of electric lights, mating will occur earlier than normal. This has actually happened to some ranchers who have used electric lights in their sheds while caring for the animals in the evenings. When they tried to mate their mink at the usual time, the mating season for these mink had passed. It also may be possible to retard or stop the onset of the mating season by allowing less light to get to the mink—as in dark sheds, snow-covered sheds or in mink that sleep in their nest boxes much of the day.

Body Growth

The growth rate of the mink is astonishingly rapid when compared to other farm animals, but not when compared to the smaller mammals or fowl. Mink management aims to produce a large frame

in a short time, and an animal that will have a good reproductive capacity for two to three years.

Chart 1 shows a range of weights for normal growth of male and female kits. Average mink will fall within these limits. Average weights substantially below the lower limits suggest that either your mink or your management practices are subnormal in some respect.

When mink are whelped, each kit weighs 8 to 10 grams (one-third of an ounce). They weigh 30 grams at one week of age, and from 100 to 110 grams (about one-quarter of a pound) at three weeks. The mother, of course, supplies through her milk all the nutrients for weight gains up to this stage. It is possible for a female mink with a large litter to produce weight gains in her kits equal to her own weight in from 3 to 4 weeks. This would be equivalent to a cow producing a 1,000-pound calf or a human mother producing a 100-pound baby in less than a month. That is why you must do all you can in management and feeding to help a mother mink when she is producing milk for babies growing at such a remarkable rate.

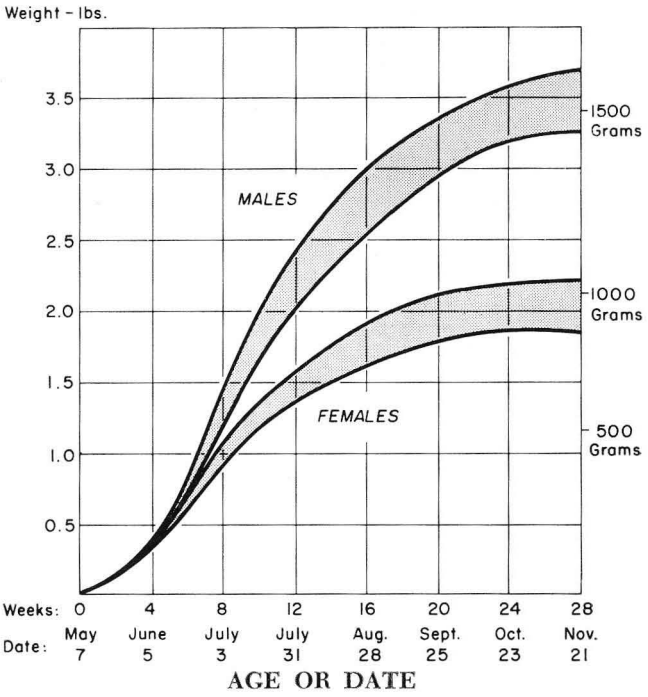


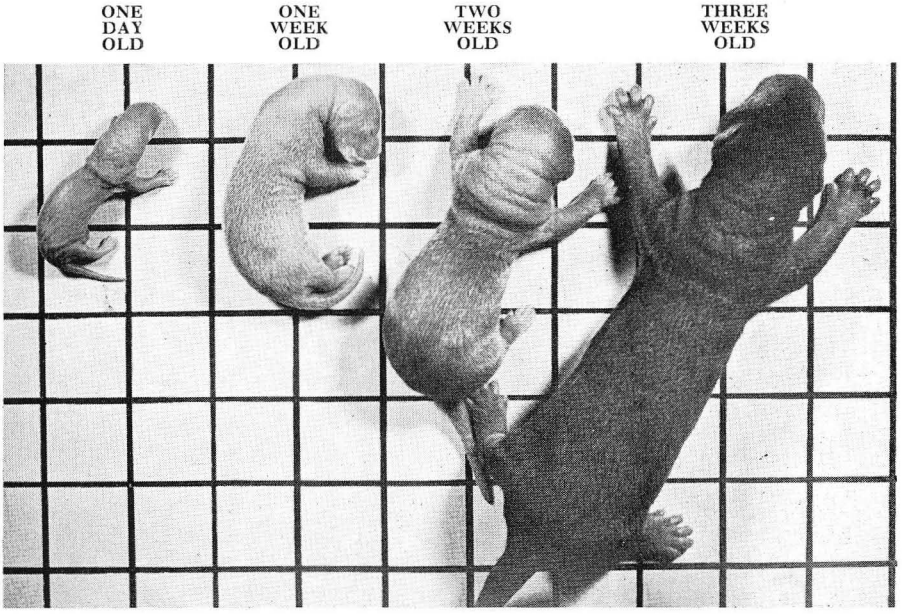
Chart 1. Range of average weights for male and female kits at different ages.

During the third week, the kits will eat some solid food if it is provided. This should be encouraged because it helps reduce the amount of milk needed from the mothers. Even after the kits start eating solid food, the amount of milk supplied by the mothers is still great.

Mink kits weigh about 300 grams or 10 ounces at six weeks. After that the growth rate continues rapid, though proportionately not as great as that of very young kits.

The growth pattern is remarkably designed to take into account the need for various types of body growth, fur growth, the nutrients available, and the changing of the seasons. First, there is emphasis on development of the skeleton or framework. A kit at 7 weeks of age already has 60 percent of its body length, and at 11 weeks it has 80 percent. By 16 weeks (approximately September 1), the female has about 99 percent of her body length and the male about 95 percent. There is a slight increase in the body length of the male after the first pelting season but this is not true of the female.

There is a corresponding, but less rapid, growth of other organs in the body. At 6 weeks the mink has 20 percent of the final body weight; at 8 weeks 40 percent; at 11 weeks 60 percent; at 16 weeks



Growth of mink kits during the first three weeks. Average kit attains 10 times its birth weight at 3 weeks, solely on mother's milk. Grid is 1 inch square.

(September 1) 80 percent. Some mink ranchers believe that, if the growth rate is retarded during the first 16 weeks, the mink cannot regain this lost growth later in its growing period. Other species can recover and become normal-sized animals, but mink may be unable to do this.

Most wild and many domestic animals go through a cycle of depositing fat in the fall and gradually losing it through the winter and spring months. This also occurs in mink. After September 1 and the completion of the skeletal growth, much of the weight gain is fat. The development of the winter pelt which is so important to the rancher also starts at this time.

Hair and Pelt Development

The skin of the mink is made up of two distinct layers. The outer part or epidermis, consists of flat, horny cells that are constantly being shed, supported by replacement cells. The under layer of skin (dermis) has various types of cells for support and elasticity.

Hair follicles are thin, sac-like sockets in which the hairs develop. They are located within the skin layers and the number is fixed at birth. In the prime pelt there is usually only one hair in each follicle. A group of hairs penetrate the skin as a bundle. The number of hairs per bundle that finally develop depends not only on heredity but environmental conditions.

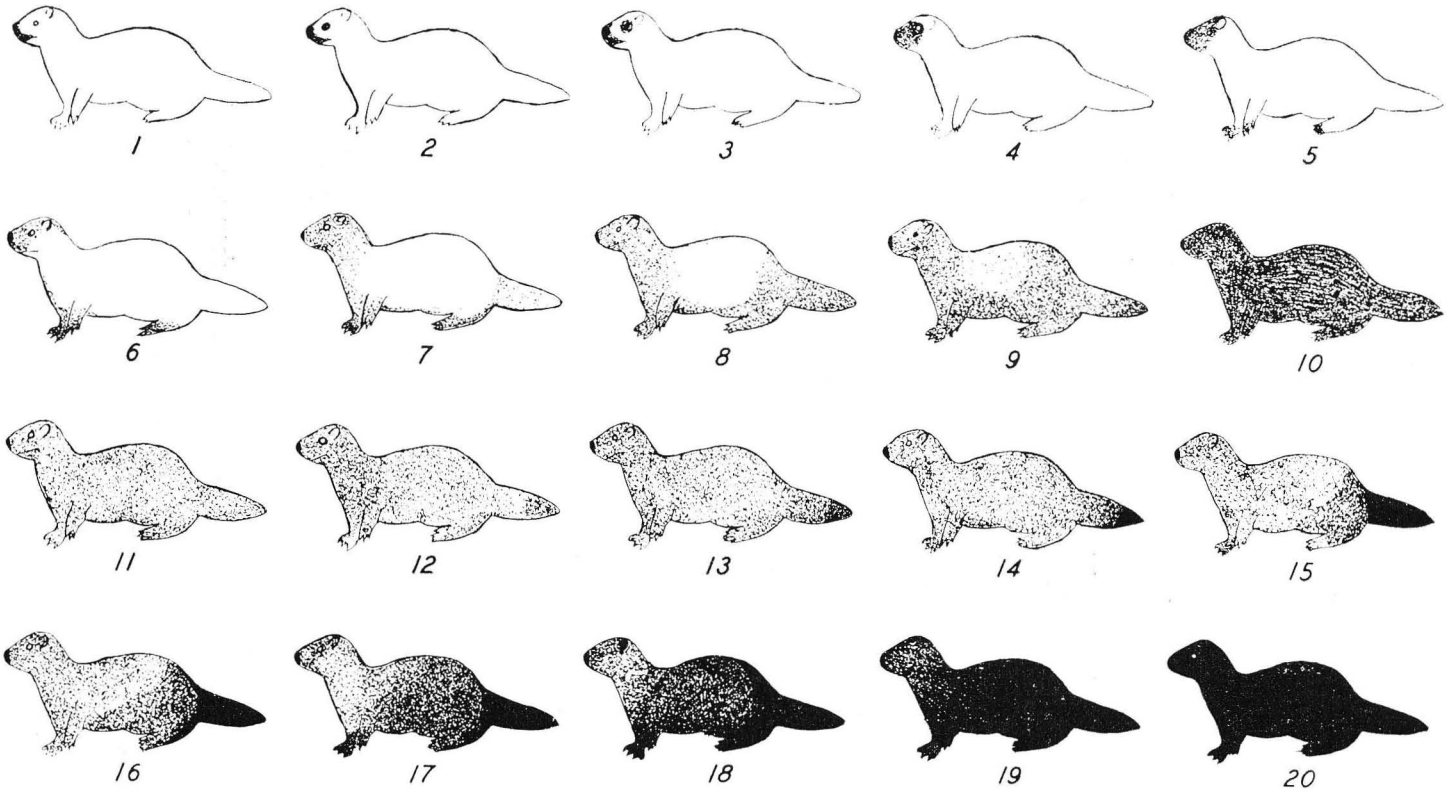
Mink develop three types of hair.

(1) The *guard hairs* are straight hairs about ¾- to 1-inch long.

(2) The *underfur hairs* are shorter and may have 4 to 6 crimps. The ratio of underfur to guard hair is about 17 to 1, but may vary between 9 to 1 and 24 to 1.

(3) The *intermediate guard hairs* are similar to the guard hairs at their tip, but are fine and crimped at their base, like hairs of the underfur.

During hair growth there is considerable change within both the follicle and the skin. Much of this change is not apparent to the rancher. When the new hair begins to develop, the follicle is deep within the skin. Because of this, the pigment of the hair can be seen on the leather side of an unprimed pelt. As the hair grows and the leather becomes prime, the follicle shortens and gradually



Stages in the molting pattern of the adult mink.

Greatly magnifiied cross section of skin showing hair roots in several stages of growth.

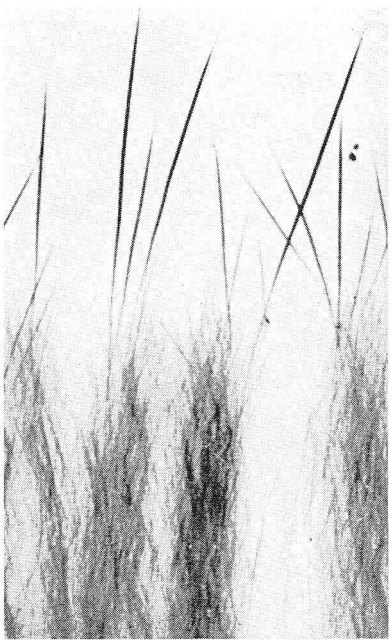
moves closer to the skin surface. Other changes in skin color and structure during the priming process are not completely understood.

Color in the hair is due to tiny pigment granules within each hair. These pigments vary from a very dark to a light yellow brown. Differences in the color of the hair result from differences in color, size, number, shape, arrangement and intensity of the pigment granules. The hair pigments are found in the inner two layers of the hair (the medulla and the cortex). The outer layer (the cuticle) contains no pigment; its main purpose is that of protection.

The mink develops two coats of fur a year: The summer coat, from April to July, has little economic value. The winter coat, pro-

duced from August to December, is commercially important because it is much darker and denser.

Changes occur in the fur of adult mink from season to season. About the middle of April or a little later, a small ring of new hair around each eye becomes apparent, giving the mink a spectacled appearance. This gradually spreads around the muzzle and up and over the face. Around the middle of May, some new hair on the front and hind feet can be noticed—gradually spreading up the legs and into the shoulder and flank area. Production of new hair along the tail and up the back commences around the middle of June. As the new hair comes in, the old hair is shed. A completely new summer coat is achieved the middle of July.



Tuft of adult mink hair. Longer, straighter guard hairs rise above the more numerous hairs of the underfur.

The rate of development of the winter, or marketable, coat depends on the strain of mink, as well as certain management practices such as feeding and lighting. The order in which changes occur is as follows: Starting in late August or early September, the skin of the outer end of the tail becomes a bluish color and new guard hairs can be seen in the summer coat which now appears dull. The development of new hairs gradually spreads up the tail and extends the full length of the tail by the end of September. During October, growth of the new hairs progresses over the hips, sides and back and onto the shoulders, neck and head. The hairs (fur) continue to grow in length throughout November until the mink becomes prime. During the later stages of fur development, the animal is dusty in appearance, especially about the head and neck. As the animal comes into complete primeness, the dustiness disappears and the pelage, or fur, will be clear and glossy. This is one indication of primeness in the mink.

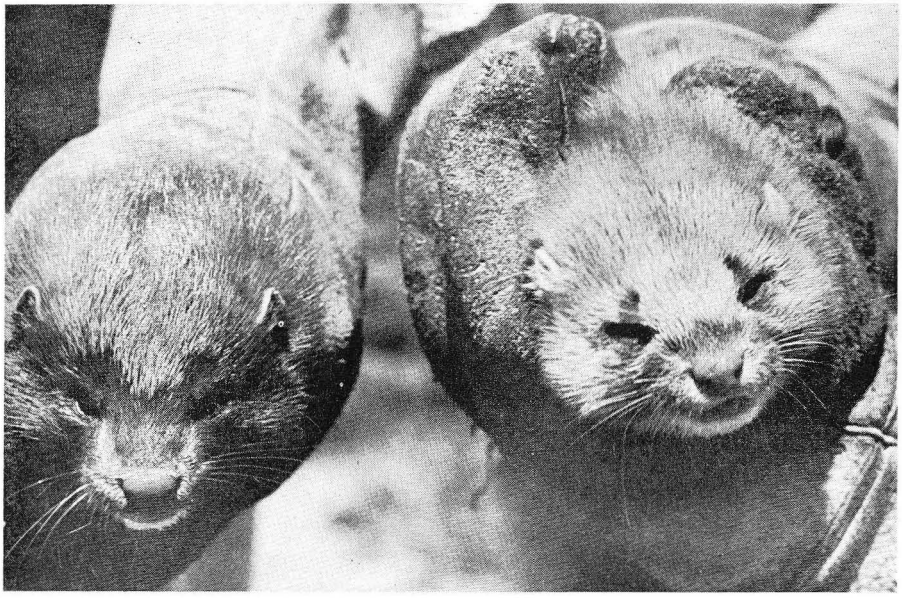
Kits born in May develop two coats in the six- to seven-month period from birth to pelting. When kits are born, the skin is pink

and smooth. After about a week, guard hairs become visible and from this stage the first summer coat develops gradually. In general, the development of the winter coat is similar to that of adult mink, but the timing may be slightly different.

How can ranchers tell when their mink are prime? This is difficult for the beginner. All mink do not become prime at the same time. Three tests for primeness are commonly used. *First,* pigment can no longer be seen in the skin which becomes creamy-white. *Second,* the scurfiness and dustiness goes out of the fur. *Third,* the hair ceases to grow. When the hair appears thick and dense in the area between the ears and about the head, its growth will be completed on the other areas of the body.

Perhaps, the one best method by which the beginner can judge primeness is to note the color of the skin. Catch the mink and part the hair between the ears forward to the eyes. If the skin is a creamy-white, chances are the mink is prime.

Many ranchers kill a few mink, skin, scrape, and put the pelts on boards before they start killing the bulk of the mink of a certain strain. If these sample mink are prime and do not have blue or grey skins, killing is continued. If the pelts are not prime, the ranchers delay pelting operations.



Two stages of spring molt pattern in adults.

The Digestive Tract

Dietary requirements vary extensively between species. This is due to such factors as the size of the gut, rate of food passage, type of intestine and the production of nutrients by bacteria in the gut. The mink is unique in its type of digesive tract. It is a flesh eater by nature and has a digestive tract about four times its body length. This is very short compared to a digestive tract of five times its body length for the cat, six times for the dog, ten times for the rabbit and twenty times for the cow. The stomach has a capacity of about two ounces—not a large amount relative to the size of the animal compared with other species.

The rate of food passage in mink of from two to four hours is rapid compared to other domestic animals. In humans the rate is 25 to 40 hours, adult chickens 12 to 18 hours, and the dairy cows 12 to 24 hours.

This combination of a small-capacity digestive tract and a rapid rate of food passage explains why it is so important to feed the mink several times a day during certain nutritionally-critical periods such as lactation and early kit growth. It also explains why the diet must include concentrated, readily available feeds.

The mink is also different in its food utilization in some other ways. It has no cecum (blind gut) and the large intestine is relatively undeveloped. Thus, the mink does not benefit from nutrients produced by bacteria in the digestive tracts as do animals with more complex digestive tracts (rabbit, cow, etc.).

All the factors listed above indicate that the nutrient requirements of mink are more critical than for many other species of domestic animals. This means that mink must receive in their diet all the different nutrients that their bodies need for a particular stage of life.

With these considerations in mind, let us discuss what is known about the ability of the mink to utilize different nutrients. As might be expected, mink utilize protein very efficiently if the protein is of good quality. Its utilization of dried protein is not as efficient as that of fresh protein. The mink is able to utilize fat in large quantities. Surprisingly, it is quite well able to utilize the carbohydrates of cereal grains such as wheat, rice and oats. The question of its relative ability to utilize raw vs. cooked cereals has not been fully determined.

This, then, is a brief review of the biology of the mink compared to some of the other animal species raised under domestication and it should help to explain some of the practices that appear to be unique to mink husbandry.

VII. FOODS, FEEDING AND NUTRITION

Foods used by mink ranchers trace their origin to foods consumed by mink in their wild state. In Michigan, two types of ranch foods have evolved—one based mainly on meat, and the other on fish. At first, the meat portion of the ration consisted principally of horsemeat, but now substantial amounts of slaughterhouse byproducts are used. The fish may be whole fish, fish racks (from filleting operations) or their combination from either ocean or fresh water fish.

A wide variety of ingredients are used in mink rations, depending on differences in availability and price. The variety of formulations illustrates that mink may get the required nutrients from many different sources.

Feeding by Season and Stage of Life

Nutritional needs of mink change with stages of growth, development and reproduction, and its food must be adapted to these changes. From December 1 to March 10, for example, the adult animals are being conditioned for breeding and reproduction. They already have normal size, and a prime winter coat. They merely need enough food to maintain themselves in a not-too-fat, not-too-thin condition. Usually less red (muscle) and more light (non-muscle) meats and fish are fed with fortified cereals. In March, the mink are bred and gestation begins in the female. During this time, feed formulations can be fairly simple. Amounts of liver and red (muscle) meats are increased somewhat over maintenance needs.

The next, and most important period, is from April 1 to July 1—during late gestation, whelping, lactation. Foods have to be well balanced and sufficiently high in energy to permit the mother to whelp normally and produce ample milk for her litter. A poor ration or insufficient food during this period will affect the size of the new-born kits and milk production of the mother. During this period her feed should be relatively high in red meats and liver and low in light meats and fish, and contain fortified cereal. The male, of course, can get by on a maintenance ration.

The next two months, July and August, is an interval of rapid growth of the kits, a tapering off of the nutrition of the female breeders and maintenance feeding for the adult males. Ration of the kits should be similar to the breeder ration with less liver.

During the next quarter, September 1 to December 1, the kits' summer fur is replaced by the winter fur and a prime pelt. Some additional growth occurs but at a reduced rate. The adults also change their summer coat for a winter coat. Insufficient or unbalanced food at this stage will impair fur quality. Under these conditions, overall growth of the kits takes place at the expense of fur quality. Their diets usually contain considerable cereal and little or no liver. Adult males and females can get by on maintenance foods.

This indicates that mink foods must meet precise requirements for a particular stage of life, to give the most efficient and least costly nourishment. Overall nutrition must meet all the specific needs for growth, reproduction, lactation, maintenance, fattening, etc. Consider maintenance requirements for example. The animal remains in equilibrium—with neither gain nor loss in weight. Food is needed primarily to renew body tissues, provide digestive juices, keep up the body heat and supply energy for a minimum of action. Non-breeding adult animals require only a maintenance ration. On the other hand when young kits are growing rapidly, the proportion of food needed for growth is higher than when growth slows down. However the food they require for maintenance is substantial in either case.

Only after maintenance requirements of the animal are satisfied, can growth in young stock or fattening in mature mink occur. True growth means an increase in tissues composed of water, protein and minerals; whereas fattening usually means only a deposition of fat. The mink's digestive tract is short and digestion fast—time of food passage may be only two hours. Mink grow two fur coats a year and mature in the short span of seven months. Thus, their food must be highly digestible and efficiently assimilated.

Can feeding help reproductive performance? This period, more than any other, either makes or breaks the mink rancher because he must get kits before he can grow pelts. Undoubtedly, feeding plays an important part. However other important factors are also involved in reproduction.

The upper limits for the size of litters and the rate of growth of kits are inherited. The kind of job the rancher does in nourishing his mink determines only how much of this inherited potential he realizes. Feeding poor stock good food or feeding good stock poorly is bound to be unprofitable. Good nutrition cannot improve upon nature, but inadequate nutrition can retard it.

Diseases, even though too slight to be apparent, may cause the animal to eat less and thus adversely affect reproduction. Booster foods containing high levels of critical nutrients and antibiotics may be of some help in this situation. Antibiotics reduce spoilage of food during storage and while on the boards before it is eaten.

Successful reproduction depends upon good performance during mating, gestation and lactation. As mentioned, mink should be conditioned prior to mating either by curtailing the amount of food or using a bulkier, less nutritious food. Restricted feeding indirectly influences the amount of light animals receive. Hungry animals run more in their cages and thus receive more light than well-fed animals which stay more in their nests. If the animal does not receive sufficient light, the onset of breeding is delayed.

During gestation there is build-up of food needs in the female due to the growth of the fetuses but the increase is not great until the late stages of pregnancy. The frequency of feeding need not be stepped up. The adult male animals during breeding need a maintenance diet. But if they become thin, larger daily rations should be fed until they regain their normal condition.

Lactation is critical and the mother must have enough food for milk to enable the kits to grow and at the same time to meet her own needs. The mothers should be induced to consume the greatest possible amount of highly concentrated food until the kits are weaned.

The investment in animals is so great that you cannot afford to take chances with any but the best nutrition. If the food does not do the job intended, it is expensive no matter what it costs. While it is good sense to feed as inexpensively as possible, it is not economical to short-change good nutrition and wind up with pelts of inferior quality and little or no profit. Nutritionally inadequate diets or insufficient food do not produce high quality pelts. You should feed for the best fur the animal can produce. This is particularly important to keep in mind when lowered pelt prices cause ranchers to try to reduce their food costs.

Fresh ingredients of good texture are palatable—the fresher the ingredients, the better. Stored meat and fish products should be well packaged, sharp frozen, and kept frozen under good conditions. They should not be thawed and refrozen, nor stored too long—the less time, the better. Coarsely ground meat and fish products are highly palatable.

Keep in mind that feeding is *not just a daily chore.* It is a time when the good rancher carefully observes his animals, and when he decides what improvements or corrections are in order.

Nutrients—Their Values and Results of Deficiencies

Ranchers should know the nutrient values contributed by food ingredients in order to understand how rations are formulated. Those who plan to buy their foods ready-mixed or to rely on technical knowledge of others may omit the following section discussing nutrient values.

Mink foods are blends of ingredients which are composed of various nutrients. All nutrients are important—if any essential one is deficient, it is the critical nutrient for that ration. Deficiencies of energy and protein, which have little body storage, cause prompt, unfavorable responses in the animal. On the other hand, minerals and fat-soluble vitamins accumulate in the body and so mink react more slowly to these deficiencies. Multiple and slight deficiencies of nutrients cause reduced appetite and body weight, lack of luster in the fur and a generally unthrifty animal. Gross deficiencies of specific nutrients cause symptoms which are recognizable to nutritionists.

Despite considerable information on practical feeding, little is known of the mink's exact nutrient needs. Their rapid growth and the relatively high level of energy of the food normally consumed, suggest that the usual known nutrients are needed in substantial amounts. Many of the requirements suggested for mink are based on experiments with foxes and other animals and are therefore tentative until specific data on mink are obtained (Table 5). There is a need to establish requirements upon which to base food formulation.

Protein—The need for protein is actually for the 22 or more amino acids of which they are composed. Different combinations of these amino acids produce proteins that have very different physical characteristics—for example fur, skin and muscle.

The value of a food protein to mink depends not only on its digestibility but on its having a wide assortment of "essential" amino acids. An essential amino acid is one which cannot be formed in the body fast enough to meet nutritional needs. To be useful nutritionally, the digestible protein must be of high "biological value". This depends on the amino acids available, the animal's requirements for them, and its ability to synthesize needed amino acids. Proteins from red meats, glandular material and fish have high biological value, while those from tripe and lungs have lower values. The true value of a protein thus depends on both digestibility and biological values. Proteins,

if eaten in excess, are not stored in the body as such for future use as are fat and some vitamins.

According to the National Research Council, mink kits between the ages of 7 and 16 weeks need 22 to 26 percent protein on a dry or moisture-free basis (7.3 to 8.6 percent on an "as fed" basis). Kits from 16 weeks of age to maturity need 16 to 22 percent protein on a dry basis (5.3 to 7.3 percent "as fed" basis). Most mink rations have substantially more protein than needed because they are based on high-protein animal and fish products. If minimum levels of protein are used, its quality must be high to get top performance.

Fats—These substances have over twice the energy value of carbohydrates or protein and are the most important single source of calories in the ordinary mink diet. They may also be carriers of vitamins A, D, E and K. High-fat diets cause animals to eat less food, so such diets must be highly fortified with the other nutrients. Otherwise, marginal deficiencies may occur. When the quantity eaten exceeds nutritional needs, fat is stored in the body.

Fat levels up to 30 percent of the ration have been fed to growing mink without harm. Lactation creates the greatest drain on the mother's body reserves and steps up food requirements. Adding fat is the easiest way to provide more energy. However, fat must be considered from many standpoints—its relation to stage of life, its great variability in ingredients, its contribution of energy, its relation to protein and other nutrients, its degree of saturation, its relative susceptibility to oxidation and rancidity, its freshness, etc.

Greater use of low-fat products such as smelt, whiting and whale meat, along with less horsemeat, has tended to lower the amount of fat in mink diets. Where low-fat products are inexpensive, addition of fat is usually economical. It is unwise, however, to pay a premium for low-fat ingredients and then add fat.

The level of fat in the diet is related to the level of protein and other nutrients. Too much fat may cause nutritional problems unless you have ample protein, vitamins and minerals. You should check the fat and protein already in the diet before adding more fat.

Different food ingredients vary greatly in fat content. For example, whiting has less fat than turbot, smelt has less than carp, melts (spleens) less than udders. Lean horsemeat has only four percent fat while regular horsemeat may contain fifteen percent. A variation of 10 to 20 percent or more in many ingredients is common.

Also, methods of processing affect fat content. Steamed tripe has less fat than raw tripe and local supplies of raw tripe may vary considerably depending on the amount of abdominal fat present. Fats of certain types may deteriorate during long storage. Those from the flesh of horses and fish are highly unsaturated—which means they can take up oxygen from the air (oxidation) during storage. This creates toxic peroxides and destroys vitamins A, E and thiamine. Absorption of such oxidation products causes highly-colored fat deposits under the skin called "yellow fat".

Very low temperatures (0 to −10° F.) and antioxidants give some protection against deterioration in storage. Antioxidants are not nutrients. They help preserve certain nutrients against destruction by oxidation. Many ranchers still favor lean meat and fish products to avoid rancidity during storage. When needed, use fresh fat or fat stabilized with antioxidants.

Energy—While mink get most of their energy from fat, they get some from proteins and carbohydrates. Animals eat primarily to satisfy their energy re-

quirements. If their food is diluted with poorly digestible ingredients, they will eat more food to compensate for the lack of energy. If the energy level in the food is greater than needed, fat will be deposited. For top efficiency of food utilization, the amount of energy is related to the protein level of the ration.

Carbohydrates—Cereals supply the major part of the carbohydrate in mink foods. In a typical ranch ration composed of 80 percent animal products (75% water) and 20 percent cereal (10% water), the cereal or dry mix supplies as much dry matter as fresh meat and fish. A ration containing 35 percent cereal gets two-thirds of its dry matter from this ingredient. Consequently, the cereal or dry mix is very important. The carbohydrate of raw wheat and oat cereals is quite easily digested by mink, but that of raw corn meal and potatoes causes digestive disturbances unless cooked. Some ranchers claim that raw wheat sours quickly on the feed boards. Commercial cereal mixtures are usually cooked and offered with or without protein, vitamin, and mineral fortification.

Vitamins—Vitamins A, D, E and K are fat-soluble; B-vitamins are water-soluble.

Animal and fish products, feeding oils, and liver are the chief sources of vitamin A in the diet. Pro-vitamin A (carotene) does not contribute much because only small amounts of plant products are used in mink foods. Vitamin A stimulates new cell growth and helps protect mink from infections. A deficiency of it produces poor appetite, trembling and "cocking" of the head, running in circles, and injury to the eyes (xerophthalmia). The vitamin A requirement of mink is about 780 International Units per pound of feed (dry basis). It is assumed that mink can use carotene as a source of vitamin A but not as efficiently as the vitamin itself.

Vitamin D is associated with the utilization of calcium and phosphorus. Rickets develop only when calcium or phosphorus is grossly deficient. This ailment causes poor growth, lameness and swelling of the ribs. Vitamin D will help prevent these symptoms but will not cure malformed bones once they have developed. Mink can produce their own vitamin D if they get direct sunlight. Vitamin D supplements are not necessary when mink get practical diets. However, some source of the vitamin is usually added to mink foods for insurance.

Vitamin E is of importance as a vitamin and an antioxidant. The antioxidant property retards oxidative destruction of certain nutrients. A deficiency of vitamin E causes retarded growth rate, muscular weakness and poor reproduction. This deficiency is associated with "yellow fat" disease or steatitis, in which the body fat is yellowish-brown. Young animals have difficulty in walking, go into a stupor, and finally die. The yellow color of the body fat is due to the consumption of unsaturated fats, like those found in fish oils and fish products, which have become oxidized and rancid. Commercial supplements and wheat germ oil or meal are added to mink rations to supply vitamin E and prevent oxidation during storage. Nevertheless, it is not safe to store feed ingredients too long. And do not let the mixed feed stand around.

Vitamin K is necessary for the normal clotting of blood. Too little vitamin K is said to cause severe bleeding in case of injury. Normal adult mink do not require a dietary source of vitamin K as they can synthesize sufficient for their needs. The needs of vitamin K for mink with enteritis and for very young kits are unknown. Dehydrated alfalfa meal is a good source of this vitamin.

Synthetic menadione or menadione sodium bisulfite—two highly active forms—are sometimes used where bleeders are a problem.

Unidentified nutrients—Mink do better when certain ingredients are present in their ration. These include liver, yeast, skimmilk, alfalfa meal, fish solubles, fish meal and wheat germ. All are rich sources of the B-vitamins, and other required, but unidentified, nutrients.

Lack of thiamine (vitamin B_1) in adult mink causes loss of appetite, weakness, emaciation, muscular incoordination, diarrhea, collapse and death—frequently in about a week. This is called "Chastek's" paralysis. Young mink may die very quickly with no preliminary symptoms. The paralysis results either from a lack of thiamine in the diet or from destruction of this vitamin in the food by an enzyme called thiaminase. This enzyme is found in certain species of fresh water and ocean fish. Cook this type of fish to destroy it or feed the raw fish every other day (so the enzyme can't destroy the thiamine in *all* the food). Thiamine occurs in cereals, animal and fish products, yeast, etc., and thus there is no problem in obtaining it. The real problem is keeping it from being destroyed by any thiaminase which might be present in the raw fish.

Deficiency of riboflavin causes muscular weakness, spasms, coma and blindness. Fish, meat, milk and yeast supply substantial amounts of riboflavin. Cereals are not a good source. Riboflavin itself can be added to some mink foods economically, though practical rations aren't deficient in this vitamin.

Deficiency of pantothenic acid causes cessation of growth, graying of the fur, enteritis, fatty degeneration of the liver, swelling of the kidneys, coma and death in foxes, possibly also in mink. Fermentation and milk products, alfalfa meal and the synthetic vitamins are good sources of this vitamin.

Deficiency of pyridoxine (B_6) results in poor growth and anemia in foxes—probably also in mink. Cereal products, fermentation products, liver and yeast supply this vitamin.

Lack of niacin causes weakness, loss of body weight and "black tongue" (severe inflammation of the gums, lips and tongue), diarrhea, coma, and death in foxes. It is thought the same would occur with mink. Meat, fish, liver and yeast are sources of niacin in the food.

Folic acid is essential for growth and formation of red blood cells. Its absence causes fatty degeneration of the liver, a hemorrhagic inflammation of the gastro-intestinal tract, loss in weight and anemia. Folic acid is supplied to the mink diet by liver and alfalfa meal.

Blood cell formation requires vitamin B_{12}. Products of animal and fish origin provide this vitamin. Liver is an especially potent source. Byproducts from making antibiotics are another source. A lack of this vitamin retards growth and lowers vigor.

Choline is concerned with the metabolism of fat in the body. Other animals need this compound and mink probably do too. A lack of it in other animals affects growth and creates abnormal leg bones.

Suggested levels of vitamins are based to some extent on experiments with other animals. In the case of riboflavin, pantothenic acid, pyridoxine and niacin, additions at specific levels prevented deficiency symptoms in mink but did not establish minimum amounts necessary.

Minerals—Calcium and phosphorus are needed for normal functioning of many tissues. They are especially important for bone formation. A lack of calcium and phosphorus produces rickets.

Both minerals make up a substantial part of the bone of meat and fish products, etc., and bone meal itself. The ratio of calcium to phosphorus is as important as the amount of either element. Only when this ratio is abnormal is vitamin D required. For growing mink, from 0.4 to 1 percent of calcium and 0.4 to 0.8 percent phosphorus are satisfactory if the ratio is between 0.75 and 1.2 parts of calcium for every 1 part of phosphorus. The minimum requirement for both calcium and phosphorus in the dry diet is below 0.3 percent if the vitamin D supply is adequate.

Salt is found naturally in animal and fish products, but is commonly added to mink diets. It is of special value for nursing mothers. Frequently, iodized salt is used. Commercial cereals contain some salt, so do not add extra salt before checking the amount in your cereal.

Iron, manganese, copper, cobalt, potassium, zinc and magnesium are found in practical mink foods. Lack of iron, copper and cobalt results in anemia. Lack of any of these trace minerals cause poor growth and unthrifty use of food.

Quantitative requirements for many nutrients are unknown. Table 5 lists mink requirements—some known and some estimated from other species' needs.

TABLE 5—Estimate of nutrient requirements per pound of food for growth and fur development of mink

	"As fed" or wet basis	Moisture-free or dry basis
Protein (percent) 7 to 23 weeks of age	7.3	22
Protein (percent) 23+weeks of age	5.3	16
Vitamin A (IU)	260.0	780
Vitamin D	*	*
Vitamin E (mg)	4.0	12.0
Vitamin K (ug) less than	4.0	12.0
Thiamine (mg)	0.16	0.5
Riboflavin (mg)	0.3	0.9
Pantothenic acid (mg)	1.2	3.6
Niacin (mg)	1.5	4.5
Pyridoxine (mg)	0.16	0.5
Folic acid (mg)	0.03	0.09
Vitamin B_{12} (ug)	1.3	4.0
Salt (percent)	0.16	0.5
Calcium (percent)	0.13	0.4
Phosphorus (percent)	0.13	0.4
Ca:P ratio	1:1	1:1

*Diet of natural feedstuffs with normal Ca: P ratio was adequate without added vitamin D.

Water—It softens food and aids digestion. It regulates body temperature through evaporation from the lungs and body surfaces. And it serves as a solvent for various physical and chemical reactions. It makes up about two-thirds of the weight of mink.

This "nutrient" is especially important in very hot or very cold weather. In very hot weather, water mink more frequently. In winter, be sure that

plenty of water is available because mink have difficulty obtaining enough water from licking ice.

Ranch-type mink foods contain from two-thirds to three-fourths water, depending on the amount of meat and fish used. Cereal dry mixes have only about 10 percent.

Food Ingredients and their Place in the Ration

Consider availability, price, freshness and quality of the key food ingredients when you decide on the basic character of the ration. Along the sea coasts and Great Lakes, low-cost fish and fish products are usually in good supply. In the Midwest and mountain states, meat products are more abundant and thus more economical. However, in these and in most other regions, a combination of meat with some fish, or vice versa, provides the foundation on which mink rations are built.

Meat products—Horse meat, once widely used as an ingredient in mink foods, has now largely been replaced by lower-cost packinghouse, poultry, and fish products. Regardless of the source, nutritional value of any animal byproduct depends on relative proportions of muscle, connective tissue, cartilage, bone and fat.

Liver, tripe, melts, lungs, udders, unborn calves, etc. are common ingredients in mink rations. Beef, pork, poultry and horse byproducts are used, as well as rabbits and muskrats. Dry meat meal also is used to some extent.

Tripe, melts, lungs and udders are proven mink foods but can replace only part of the muscle meat. Commercial byproduct mixes vary considerably from one manufacturer to another. The guaranteed amount of liver and fat is an index of the value of these ingredients, so be sure to check it.

Fats—Obtained from livestock processing, these are sometimes added to provide a highly efficient source of calories. Good diets run about 5 to 7 percent on an "as fed" basis. The lower level is used during breeding and whelping; the higher level during growing and furring when higher cereal levels are used.

Table 6 lists the composition of various meat products used in mink feeding.

Liver—This is considered the most important single ingredient for good reproductive performance and early growth of kits. Nutritionists recommend from five to ten percent liver in reproduction

TABLE 6—Percentage composition of ingredients used in mink foods

Ingredient	% Moisture	% Protein	% Fat
Muscle meat			
Horse meat, lean	74	18	4
Horse meat, fat	63	18	15
Horse meat and bone	70	17	5
Muscle meat, beef	69	21	7
Whale meat	70	24	3
Meat byproducts			
Brains, beef	80	8	9
Cow bags (udders)	65	12	13
Esophagus and windpipe beef	76	10	6
Gullets, beef	55	16	5
Kidneys, beef	71	10	9
Lips, beef	67	18	13
Liver, beef	73	20	4
Lungs, beef	79	16	3
Spleens, (melts) beef	77	18	2
Tripe, beef	75	12	2
Blood meal	14	84	1
Liver meal	6	67	14
Meat scraps, 48 to 53% protein	5	51	12
Poultry and Dairy Products			
Cottage cheese	75	22	0
Eggs, whole	75	13	10
Milk, dried skim	4	35	1
Poultry, heads	67	19	6
Poultry, feet	53	25	11
Poultry, viscera (washed)	86	10	4
Poultry, byproducts, mixed	70	17	7
Whey, dried	6	12	0
Fish			
Alewives	74	19	4
Burbot	77	14	6
Carp	67	16	12
Hake	80	15	2
Herring, lake	75	15	3
Menhaden	60	19	10
Rockfish, red	72	18	6
Salmon, Alaskan	69	18	11
Sheepshead	69	16	7
Smelt	72	16	4
Sole, English	76	15	3
Sucker, common	75	15	5
Whiting	78	16	2
Cereals, vegetables, etc.			
Alfalfa leaf meal	8	20	2
Apple pomace, dried	11	4	5
Beet pulp, dried	8	9	0
Corn, cooked and flaked	3	7	3
Oats, rolled	8	16	5
Potatoes, white	78	2	0
Soybean oil meal, solvent	8	46	1
Tomatoes, dried pomace	5	22	14
Wheat, cooked and flaked	3	6	0
Wheat, dried bread	13	11	1
Wheat, germ meal	9	31	9
Yeast, dried brewers	7	43	1
Yeast, dried torula	7	49	2

and lactation rations and up to five percent for growth and furring. However, in the growth and furring stage, animals can actually get along with little or none at all. Don't skimp on liver when it costs no more than muscle meat. It has the protein value of muscle meat plus more of the essential vitamins and minerals. As far as is known, livers of many animal species are equally as nutritious for mink. Liver byproducts may also be used to a limited extent.

Poultry byproducts—Byproducts from chickens, duck and turkey processing plants are equivalent to meat or fish products. These plants supply heads, feet, entrails and occasionally backs and necks from cut-up poultry operations. If handled promptly and properly, fresh or cooked poultry wastes are satisfactory in mink foods. Entrails are best, heads next best, and feet least valuable. Poultry byproduct mixtures have about two-thirds the nutritional value of meat, but usually cost only a third as much.

Poultry wastes should be cooled promptly and handled in a sanitary manner. Otherwise, decomposition will give a poor quality product. If in good and fresh supply, poultry byproducts may make up to 30 percent of the ration.

Select your source of poultry product with care. Be certain that there is no danger from stilbestrol, a hormone-like substance added to certain poultry feeds. This will be discussed later in this chapter. Laying hens and turkeys, however, are not fed hormones—so their byproducts would be safe to use. Table 7 shows the proportion by weight of different organs or parts of fowl.

Whale meat—Lean muscle from the trunk and tail of whales, is also used as a substitute for meat in the diet. The whale is a warm-blooded animal so its meat resembles that of horse rather than fish. Quality suffers if the time lapse between death and processing is too long. When properly slaughtered, handled, stored and transported, whale meat is an excellent ingredient for mink. It has more protein and less fat than meat and fish. However, it is more easily oxidized and dehydrated (freezer-burnt) during storage than other meats since it lacks a protective covering of skin and fat. Its fat is like that of fish and contains highly unsaturated fatty acids.

Milk—This ingredient contains protein of high biological value, vitamins, calcium and phosphorus and is particularly valuable during nutritionally-critical periods. Whole, evaporated and dried forms,

TABLE 7—Organs or portions of poultry as percentages of live weight or byproduct mixtures

Ingredient	Fowl			Broilers	Turkeys
	Live weight	Total waste	Entrails	Live wt.	Live wt.
	Percent	Percent	Percent	Percent	Percent
Heads	4.1	18.3	....	3.0	3.5
Feet	2.9	12.9	....	3.4	2.9
Viscera	....	....	....	12.7	8.7
Neck	2.1	....	....	....	....
Liver	2.4	....	....	....	....
Heart	0.5	....	....	....	....
Gizzard	4.1	....	....	....	....
Oil gland	0.2	0.8	1.2	....	....
Egg yolk	2.5	11.2	16.2	....	....
Feed in G.I. tract	3.8	16.8	24.4	....	....
Feces	0.4	1.9	2.8	....	....
G.I. tract	8.6	38.1	55.4	....	....

and whey may be used. Dried skimmilk and whey are usually most economical and compose up to three percent of the diet. Too high levels are laxative due to a high mineral content and poor utilization of lactose, the milk sugar. Sometimes milk substitutes, which actually contain some milk solids are fed to nursing females and kits that are not doing well.

Cottage cheese—Where the price is right, cottage cheese can replace some animal and fish products. The rancher can feed from 5 to 15 percent. Higher levels may lower food consumption. A combination of 75 percent cottage cheese, 20 percent liver and 5 percent brewers yeast is similar in composition to boneless horsemeat and may replace up to 20 percent of this meat in some rations. Since cottage cheese is low in fat, one pound of fat should be added for every ten pounds of cheese.

Fish—Whole fish, trimmings from filleting operations, fish heads, and scraps are practical for mink rations. Fish vary in food value, depending on species, season, age, food supply, etc. Some are high, others low in fat. They are all excellent sources of protein, vitamins and minerals. In coastal areas, high levels of fish are often fed. Some species contain thiaminase, the vitamin-destroying enzyme; others have a factor which causes "cotton pelt." These species are listed later; they should be cooked to be safe.

The rancher should know the kind of fish he is feeding and what it will do. Both fresh water and ocean fish are satisfactory if frozen promptly and not kept in storage too long. Fish fat (oil) is highly unsaturated—a factor which is good nutritionally but also makes it turn rancid rapidly if poorly stored.

In general, fish products can make good economical replacements for any animal product except liver. Under optimum conditions they will give kit growth and pelt quality equal to that of those raised on horsemeat. Low-fat species such as smelt and suckers should have some fat added to provide enough calories. Fish meal and condensed fish solubles are concentrated sources of protein and unidentified growth factors. They are used to some extent in mink foods. Composition of some fish products is given in Table 6.

Cereal products—Unprocessed cereal grains, singly or in mixtures, can be used to a limited extent in mink foods. The cereal is sometimes cooked overnight in a combination cooker-mixer with fish. Much of the mink food in Michigan's Upper Peninsula is prepared in this way.

In areas, as in western Canada, where there are large quantities of low-grade wheat and oats, some ranchers make a porridge by mixing 2 parts grd. wheat, 1 part grd. oats and 7 parts water and cooking in a double boiler for 2 to 3 hours, or stirring over a direct flame for 20 to 30 minutes. This porridge makes up 45 percent of the total ration.

So-called unsupplemented cereals are a blend of cooked and toasted cereal grain flakes. Corn-germ, fat-soluble vitamins and beet pulp are usually added to return the flakes to their whole grain nutritional values and to supply intestinal bulk.

In most areas, ranchers save money by using "supplemented" cereals to cut down on costly fresh meat and fish products. The supplementation given a cereal product will vary with its intended use. Some companies market a supplemented product for use up to a recommended level in the ration, and a less fortified product for use above that level. Thus, the different cereal products are adapted to the availability and price of fresh animal products. The supplementation used for cereals contains about the same quantity and quality of nutrients as the meat and fish it replaced but in a dried form.

The rancher should fully understand the differences in com-

mercial cereal products. Further, he should adhere to the manufacturer's recommendations. "Unsupplemented" cereals contain about 12 percent protein, 3.5 percent fat and up to 10 percent fiber. "Supplemented" cereal products have 20 percent or more protein, 2 to 4 percent fat and 6 percent fiber.

"Supplemented" cereal products contain cooked and dehydrated cereals, often in flake form. Fortifying ingredients include dehydrated alfalfa meal, dried tomato pomace, dried beet pulp, fish meal with fish solubles, meat meal, liver meal, dried skim milk or whey, wheat and corn germ meals, brewers or torula dried yeasts, distillers dried solubles, bread meal, oat groats, wheat bran, linseed oil meal, soybean oil meal, corn gluten meal, water-soluble and fat-soluble vitamins, antibiotics, salt, bone meal and trace minerals such as manganese, iron, copper, iodine and cobalt.

Cooked cereals reportedly are more digestible than uncooked cereals. Mink digest 90 percent or more of the starch in the cooked product. If grains are not thoroughly cooked, mink may scour.

Cereals are fed at levels of from 10 to 20 percent in the breeder ration and 10 to 35 percent in the growing and furring ration. In early fall, you can save money by increasing the amount of supplemented cereal. The critical gestation, whelping and lactation periods require more animal products and less cereals. At other times, greater use of cereal products saves money. Cereals contain far less water and thus cost less per pound of available nutrients than most other mink food ingredients.

The use of supplemented cereals saves some time and labor in mixing since one weighing adds several ingredients. At the same time, levels of other important nutrients may be increased, which is especially important when higher levels of cereal are being used.

Some cereals or cereal mixtures are marketed in crumble form. This produces denser granules less subject to oxidation. It also prevents ingredients from settling out. The granulated feeds are less dusty to handle.

Vegetables—Tomatoes, carrots, turnips, lettuce, and other green vegetables occasionally comprise up to 8 percent of home-mixed rations. Well formulated cereals provide much of the same nutritional values.

Vegetable protein supplements—Soybean oil meal, linseed oil meal and corn gluten feed are economical sources of proteins which com-

plement those from animal byproducts. They are common ingredients in cereal dry mixes.

Vitamin supplements—Brewers or torula dried yeast, dried distillers solubles, dehydrated alfalfa meal and wheat germ meal are good sources of the B-complex vitamins, unidentified growth factors and high quality protein. They may make up from one to three percent of the ration. Natural or synthetic sources of vitamins A, D, K, E, B_{12}, riboflavin, niacin, pantothenic acid, thiamine, choline, folic acid and unidentified factors are sometimes used in mink foods, especially in supplemented cereals. Well-formulated mink rations contain goodly supplies of most of these nutrients so adding them as supplements is usually unnecessary. Certain food ingredients may need additional vitamins and in any case these additives provide a kind of insurance.

Mineral supplements—Manganese, iron, copper, cobalt, potassium, calcium and phosphorus compounds supply major and trace essential minerals for skeletal development of kits as well as for functional activities of soft tissues.

Drugs and chemicals—Other substances are sometimes added in small amounts to mink foods. Antibiotics, such as penicillin, aureomycin, terramycin and bacitracin help keep foods wholesome on the feed boards for a longer period of time. Antibiotics are not nutrients. At low levels, they are believed to modify bacterial populations in the digestive tract and help desirable bacteria take over. At higher levels, they suppress disease-producing organisms.

Arsanilic acid has been fed to mink. In other species this organic arsenical apparently acts much like antibiotics. To date, researchers have not established its value with mink.

Antioxidants, such as BHT, BHA, citric acid, propyl gallate, and Santoquin, are used to preserve foods against rancidity, oxidation and "yellow fat" disease.

Freezing and Storage of Food

Ranchers who prepare their own mink foods buy meat and fish products in large lots. Much of this is frozen and stored for future feeding. This requires chilling the products promptly, freezing them at low temperaures, and storing them under refrigeration until time for use. Certain principles involved in these steps follow:

Freezing does not improve the quality of food. It merely helps to preserve the original quality. This is why the rancher must start with wholesome ingredients. The outer surface of animals, their intestinal contents, and even air and water are contaminated with bacteria which grow rapidly at warm temperatures. Low temperatures kill some bacteria but simply make others relatively dormant. Freezing postpones spoilage by suspending the growth of these "bugs".

Mink food is sharp frozen and then stored frozen until used.

Fish is more perishable than meat because organisms that flourish on fish thrive at a lower temperature than those on meat. Freshly-killed, warm blooded animals and freshly-caught fish must be chilled promptly. They are then frozen rapidly in a "sharp" freezer at -10° F. or below and stored in a refrigerator at 0° F.

Rapid freezing is important because slow freezing causes large ice crystals to form within the tissues. These crystals alter the character of the food when thawed. To step up the freezing rate, package the products in a thin (4 to 5 inches) flat shape so heat can be extracted more rapidly. The sharp freezer should have adequate capacity so each package will freeze quickly right to the center. Drying during storage, also called freezer burn, is prevented by using moisture-proof wrappings or glazing the frozen block with ice, using water near the freezing point. Spoilage starts as soon as materials are removed from storage, so do not thaw and then refreeze.

Enzymes in the flesh of dead animals also destroy tissues. These, like the "bugs", are restrained by low temperatures but go to work when the materials are taken from storage. Fats react with the air and become rancid. These changes cause loss in flavor and limit the practical storage life. Therefore, the higher the fat content, and the

greater the degree of unsaturation of the fat, the lower the desired storage temperature.

The temperature of the freezing rooms should be kept reasonably constant. Frozen meat and fish should be stacked so it is easily accessible and air can circulate freely throughout. Follow a first-in, first-out practice to avoid long storage. Food purchased frozen can go directly in the storage refrigerator. Food ingredients are usually stored separately and ground as needed because foods spoil more quickly after grinding and mixing.

Possible Sources of Danger

In recent years, many new drugs, chemicals and hormones have been incorporated in poultry and livestock feeds to stimulate growth, control diseases, prevent rancidity or improve feed palatability and efficiency. Because these substances may be detrimental to mink, ranchers should not substitute poultry, calf, and hog mashes which may contain them, for the cereal portion of mink foods. Slaughterhouse byproducts from animals that received these substances in their feed are also a possible source of danger.

Animals that have been heavily medicated prior to their death or slaughter may also be dangerous. The great variety of medications rules out any general statement on the wholesomeness of resulting products. However, caution should be exercised in using these foods. Get a guarantee from your suppliers that their products are safe for mink.

Stilbestrol—Estrogenic hormone-like substances are implanted in the ears of cattle or mixed in feeds for livestock and young poultry to improve feed efficiency or carcass quality. The implanted ears and the contents of the alimentary tracts contain substantial residues of the hormone and should not be fed to mink. In fact, 1 ear or 3 pounds of treated feed has enough residue to prevent 20 female breeders from having kits if fed throughout reproduction. Stilbestrol is a very stable compound. It resists heat and is carried by way of the fat into meat scraps, tankage, and tallow when the offal of treated animals is rendered.

Thiaminase-containing fish—Certain fresh water and ocean fish contain thiaminase—an enzyme which destroys thiamine (vitamin B_1). This causes mink to go off-feed and lose weight, develop "Chastek's" paralysis and finally die.

The enzyme is found in smelt, carp, suckers, white bass, burbot, catfish and bullheads. It is not present in chubs, Lake Superior herring, lake trout, pickerel, perch, cod, haddock, whiting, lemon sole, mackerel, redfish and rock bass. Be sure commercial lots of non-thiaminase-containing fish are not contaminated with thiaminase-containing species. Cook thiaminase-containing fish or use it only on alternate days to prevent this trouble.

"Cotton-furred" mink—High levels of raw hake or whiting in the diet cause depigmentation of the underfur, growth depression and anemia. The problem involves iron utilization and is greater in whole fish than in the cleaned carcasses. Thorough cooking avoids the danger. Certain individuals and strains of mink are more apt to develop "cotton" underfur than others. Thus, the intensity of the condition varies even with animals on the same food.

Fats—Rancid fat is mentioned more frequently than any other factor as a hinderance to reproduction. When stored under poor conditions, unsaturated fats undergo oxidative rancidity. This produces "yellow fat" disease in growing mink and is believed to affect reproduction. Antioxidants help prevent rancidity. Increased use of these substances in most fats and fat-containing products has greatly reduced the problem.

High fat levels reduce food intake and lower the consumption of other nutrients. However, most practical mink foods contain enough of the essential nutrients so that use of high-fat foods ordinarily would not cause trouble.

Spoiled and contaminated food – Growth of organisms in food causes spoilage. That is why it is particularly important to use fresh foods during the critical stages of nutrition. Letting food stand on the feed boards too long in warm weather is dangerous because it increases spoilage. Do not use contaminated food or the meat of sick animals in your ration. Pork livers infected with Salmonella can produce infectious abortion in mink. Botulism organisms that get in food ingredients may cause the production of toxins that would kill your mink. So be sure your mink foods contain only good quality, unspoiled ingredients. And take care in storing, handling, and feeding.

Pest control substances—Occasionally, mink are affected by pests. The rancher should use caution with pesticides, particularly at whelp-

ing time. To date, many insecticides haven't been tested thoroughly on mink. Substances that may poison mink are considered in Chapter IX.

Feeding Schedules

The kind of mink foods that should be fed at different times of the year and for different productive purposes are shown in Chart 2. Three foods cover the entire life cycle of the animals.

Winter food is chiefly for maintenance of adult animals prior to breeding and thus less enriched nutritionally than other foods.

Breeder-grower food nourishes the female during reproduction and the kits during initial growth. The mother mink needs lots of nutritious food to produce large litters and then nourish her kits with plenty of milk until weaning time. Further, this food must bring the kits up to almost their mature weight and length.

Pelter food brings the animal to maturity. It also provides all the nutrients for furring and priming.

While three types of foods suffice to nourish the mink the year round, some ranchers and food manufacturers use more types of food so as to adapt the diets to more specific needs. For example, some mixers market a "starter" food, "pre-breeder" food, etc. These are modifications of the foods described.

The range of ingredients that is likely to be found in representative ranch diets is given by groups in Table 8. The composition of the foods varies depending on whether meat or fish products predominate. The types of mink food used at different times of the year are shown in Chart 2. For example, food to be fed in June would be of a breeder-grower type.

A nutritionally adequate breeder-grower ration based on a combination of meat and fish according to Table 8 might be as follows:

Liver 10%

Horsemeat, or its equivalent of a mixture of Group A products such as rabbits, whale meat, eggs or cottage cheese, 25%

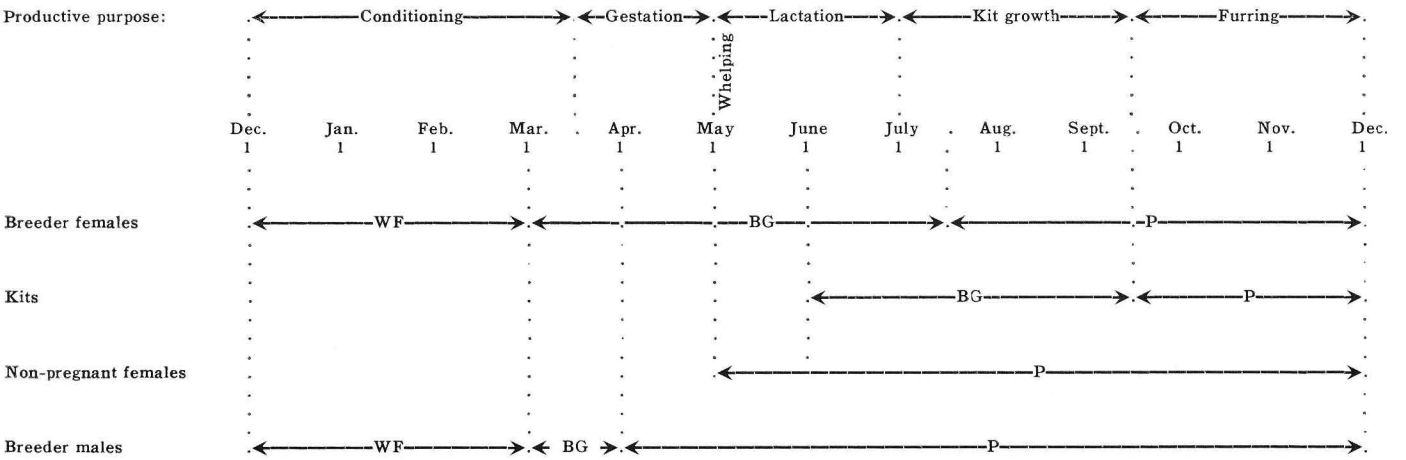
Meat byproduct mix (Group B) 20%

Smelt, sole, sheepshead or combination from Group E 25%

Supplemented cereal 20%.

The most economical diet for this period would, of course, vary

CHART 2—Kind of mink food fed with respect to time of year and productive purpose. Smaller ranchers sometimes prepare only one food—the more critical for that particular period*



*WF (Winter food)—maintenance, pre-breeding.
P (Pelter)—furring, late growth.
BG (Breeder-grower)—gestation, whelping, lactation of dams; starting, early growth of kits.

with the relative prices of different ingredients in a particular area. Staff members of the Fur Animal Project at Michigan State University will be glad to help you with your specific problems on mink nutrition.

TABLE 8—Formulas of mink foods based on combination of meat and fish —calculated prior to addition of water

	Breeder-grower	Pelter	Winter food
	Percent	Percent	Percent
Liver	5-10	0-5	0-5
Group M-1	20 or more	15 or more	15 or more
Group F-1	10-40	10-50	10-50
Group F-2	0-20	0-20	0-20
Group M-2	0-20	0-20	0-20
Group M-3	0-20	0-20	0-20
Group M-4	0-5	0-5	0-5
Cereal products	15-20	15-35	15-20

Meat and poultry byproducts*				Fish and fish products	
Group M-1	Group M-2	Group M-3	Group M-4	Group F-1	Group F-2
Horsemeat	Heart	Tripe	Blood	Smelt	Cod
Rabbits	Kidney	Lungs	Milk	Sole	Haddock
Baby chicks	Tongue	Cheeks	Lips	Sheepshead	Hake
Eggs	Gizzards	Weasand	Udders	Rockfish	Croakers
Slunks	Brains	Gullets	Oxtails	Herring	Turbot
Whale meat	Byprod. mixes	Poul. viscera	Poul. heads		Whiting
Cheese		Byprod. mixes	Poul. feet		Bloaters
			Spleen (melts)		Fish racks

*Ingredients are listed in groups in order of their nutritional value. Higher class products can always replace lower class ones, but not vice versa. This permits maximum use of lower quality ingredients. A variety of ingredients within groups is recommended.

VIII. MANAGEMENT THROUGHOUT THE YEAR

Winter Maintenance

From completion of pelting in December to the breeding season in March the number of animals is relatively small and their needs are not great. This is a period of retrenchment and preparation for the oncoming breeding and growing seasons. However, activities during this period are important. Grading records of the previous fall should be studied to develop the best possible breeding program. Re-grade the mink and cull those animals that have gone off-color. This is also

a good time for replacing old equipment, remodeling, and for indoor construction. Some ranchers vaccinate their mink at this time of the year.

Care of the animals is concerned mainly with bedding, watering and feeding. Check bedding twice a week and after each storm if the mink are in outside pens—less often if in sheds. Mink can stand almost any amount of cold if their nests are dry and contain proper nesting materials, but they are very susceptible to moisture in the nest. Watering is a problem in winter. Water once or twice a day, even in very cold weather. You might also add a little extra water to the food during cold spells.

It is best to feed in the middle of the day during very cold weather so the mink will have a longer time to eat the food before it freezes.

The type of ration to feed during this period is discussed in Chapter 7. However, let us consider effects of the quantity of food on the conditioning of the animal for breeding. From January to March there are no nutritive demands other than maintaining body weight in cold weather. After a high level of feeding in the fall, animals are often quite fat and may need to be slimmed down. During this winter period the mink should be fed so that they are in good condition—lean, but not thin. If too thin, they may suffer when extremely cold weather makes it difficult for them to obtain feed. Males that are too thin may become vicious toward the end of the breeding season. Extremely fat mink will be lazy and may not be good breeders.

The rancher should keep track of the condition of each animal. Mark excessively fat mink with a red tag and give them less feed and the very thin mink with a green tag for more feed. This system is particularly helpful if more than one person is feeding the animals. If it seems advisable not to feed the overly fat animals every day, be sure the thin ones are fed.

Breeding and Gestation

An effective breeding program consists of (1) proper mating of the female to the male best able to complement her fur quality characteristics and (2) making a satisfactory recording of the mating for future use.

Most Michigan ranchers start breeding about March 10, although some may start as early as the 5th or 6th (see Chapter 6 for a discussion

of the biology of the mink and its relation to reproduction). There are differences in optimum mating dates between certain strains and color phases of mink. Thus, when buying new stock, follow instructions provided by the seller unless your own experience proves them to be incorrect.

Whether the male should be carried to the female for mating or vice versa is a matter of individual preference and depends on the arrangement of your ranch. If convenient, it is better to carry the female to the male.

After the season is in full swing, many ranchers attempt to mate their better quality males two, and sometimes three, times a day. With planning, this can be done with certain strong males. Most ranchers mate their mink early in the morning (as soon as it is light) for two or three hours. They then feed and water the animals and attempt further matings in the afternoon until dark. Repeat matings of the females are often attempted in the afternoon. These are usually not as strenuous as the initial matings.

Another practice that will help make the males more productive is to break up the matings after 15 or 20 minutes. This length of mating is sufficient to cause ovulation in the female and to obtain a fertile mating.

The development of kit males into good breeders is an important part of the management during breeding. The success of the kit in his first attempt at mating may influence his future attitude as a breeder, so it is important that he be tried with docile females in his first attempts.

How can one tell if the mink have actually mated? The only sure method is to determine if sperm is present in the female reproductive tract. This requires the use of a microscope which will magnify about a hundred times. Several companies produce microscopes suitable for this purpose. The method for making a sperm test is described in certain publications listed in Chapter XI. Some ranchers use sperm tests in all matings. Others check the first mating of each male and repeat matings of males used often.

Males should be fed all they will eat during the mating period. After the breeding season, give the males a little extra attention as they are usually thin and need some special feeding and care.

Breeding records are important for successful breeding and herd improvement. The record can be a tag or card attached to the

female's pen or notations kept in a notebook. The record should contain the date, female number, male number and the results of the attempted mating. Some ranchers use symbols which show successful or unsuccessful matings, fights, etc. Breeding records should have a place to show when and how many kits were born. The method of keeping records is not as important as the fact that you keep them. You will then have information from which to select future breeders to improve the quality of the herd.

During April you should be preparing for the whelping season. Move the males away from the females before whelping. Care of the females consists of feeding, watering and preparing for the whelping season. Do not allow them to get excessively fat during the gestation period. Actually the amount of food required is only slightly above that of maintenance until about the 10th to 15th of April when they begin to eat more with growth of the fetuses. Even then, they should not be allowed to become too fat or it may be harmful during whelping and lactation.

False bottoms should be put in the pens about April 20. These are wire screens with mesh small enough to keep the young kits from falling through the coarser wire of the cage, and are usually turned up on the sides and ends. Some wire for whelping cages comes with narrow mesh at the bottom.

Before the expected arrival of the kits, or by the 20th to 25th of April, the females should be thoroughly bedded. Probably the best type of bedding is marsh hay, with a layer of material to insulate the bottom of the nest. Sugar cane bedding is one of the best insulating materials. Sawdust, flax, and, in some areas, the lower grades of wool are used. The idea is to provide insulation under the young kits. The mother will furnish the heat necessary from the top. Since many of the litters will not arrive until the second or third week in May, the bedding of all expectant mothers should be checked every two or three days to be sure new arrivals will have a clean, dry, warm nest. The checking also accustoms the mother to your presence and she is less likely to be disturbed if it is necessary to inspect the kits.

Whelping and lactation—Several signs indicate the arrival of newborn kits. One is observance that the mother did not eat her food; second is the glistening black dropping noted in or under the pen; third is the mewling of kits in the nest box. If the births were normal, little is required other than seeing that good quality feed and clean

water is present, the kits are warm and dry, and unusual noises are avoided. When the rancher should first observe the kits is a matter of judgment. If he opens the nest boxes quietly and looks at them without unduly disturbing the mothers, he may do some good by improving the bedding, disengaging kits from the placenta or from the umbilical cords, etc. On the other hand, a loud and excitable caretaker will do more harm than good. If the mink are nervous, they are best let alone at this time. Of course, when the rancher hears the wail of kits in distress (difficult to describe, but not forgotten once it is heard) he should check the nest box for the trouble.

Nutritional requirements of mother and kits are at a maximum at this time and proper feeding is critical. The mother's consumption increases slowly during the first week or two of lactation and then rapidly. It is imperative that she have wholesome food always available as the rapid growth of the kits makes exhausting demands on her. (See Chapter VI to help understand the great nutritional drain on the mother). Most mothers lose weight during the lactation period, an indicator of difficulty in keeping up with the demands for milk. Thus, even one or two missed opportunities for feed may have harmful effects and may possibly lead to nursing sickness.

Many ranchers mark the number of young and the date the mink are born where it can be seen by the feeder. This aids him to know how much feed the mother and litter should receive. Others mark the required amount of feed in spoonfuls or scoops, and either raise or lower the amount fed by the amount of feed left.

The kits open their eyes at about four weeks. However, they are active and moving around the nest box and pen before this. They start taking ranch food when they are about three weeks old, possibly younger. To help get them off to a good start and to relieve the strain on the mother, begin them on ranch food as soon as possible. Provide a low hole in the nest box (about two inches from the bottom) so they can crawl into the pen when quite young. Place a feeder on the floor of the pen where it is easily available. Make the food rather sloppy so mother and kits will get more water. The kits will start to eat even before their eyes are open.

During this period there are two potential dangers that the rancher must avoid—nursing sickness and heat exhaustion. Nursing sickness seems to be associated with the heavy drain of nursing the young which depletes the body of some mothers of minerals, par-

ticularly salt. The symptoms are thinness, loss of appetite and progressive weakness. Nursing sickness occurs usually in the fourth to sixth week of lactation. It can be controlled by seeing that the diet is adequate in amount and in salt content. Once it reaches the stage that the mother will not eat, it is usually fatal. However the early stages can be treated by transferring the kits and getting the mother to eat again. This can sometimes be done by giving the animal a freshly killed sparrow or chicken, or feeding milk or small pieces of liver. In some cases, force feeding for a day or two is helpful.

Unseasonably hot weather is a problem when the kits are with their mothers and nests are crowded. Apply any measures that will reduce mortality. Be prepared to take the bedding out of the nests. Water the mink often—perhaps 6 or 7 times a day. Sprinkling the pens or sheds is often helpful. (See Chapter IX for further information on nursing sickness and heat exhaustion.)

Sometimes it is necessary to transfer kits from a sick mother or from one that is not producing enough milk. This can be done quite satisfactorily providing the kits are of about the same size as those of their foster mother. To transfer, shut the foster mother out of the nest for a few minutes. When she is allowed to re-enter she will usually accept the newcomer.

If they are of normal size, kits may be weaned any time after about six weeks. However keep at least two kits to a pen until they are from 11 to 16 weeks old as they benefit from being together.

Kit Growth and Furring

Once the kits are separated, management during the growth and furring period becomes a question of feeding, watering, bedding, and sanitation. The types of rations were discussed in Chapter VII. Many ranchers skip feeding one day per week in the fall, usually September, to help keep the mink "on feed". When the mink start getting their new winter coats in September the rancher should free the pens of dirt and sticky food. A small layer of shavings or sugar cane bedding in the bottom of the nest will be adequate. In October and November, when the weather turns cold, use marsh hay. This is soft and springy and helps remove the shedding hair of the summer coat.

Fly control is important during the summer months, both from an aesthetic and health standpoint. You should reduce the desirability

of your ranch as a haven for flies and kill those that decide to stay. Good soil drainage, scraping of feeders, removing the manure once a week and spreading lime under the pens will help keep them away. For information on control of flies and rodents see Chapter IX.

Grading Mink for Herd Improvement

Grading for herd improvement is a continuous process. It should start at their birth and continue through growth, pelting and the breeding season. Let us first clarify the role of the auction house graders. They can be of tremendous help, particularly to the small and the inexperienced rancher. Graders will tell you about the type of mink and standards of quality currently desired by the fur industry. However, their value is limited for several unavoidable reasons. First, graders must visit so many ranches during the grading period that they may not always be at your ranch in good weather or when the mink are at their peak of primeness. Second, they do not have the specific knowledge of your animals that you have by living with them. Also, in most cases, they are only able to judge a small percentage of your herd.

Despite these limitations, there are several ways the auction house grader will be of value to you: He will check your evaluation of what you consider to be your best mink and the standards you use. He can help you grade larger numbers from a class where you might feel unsure and inexperienced. In the process, he can teach you what desirable and undesirable characteristics to look for. Thus, he should leave you with more information on what the market desires and how to rate these characteristics in your own mink.

Most grading, however, must be done by the rancher himself. This may start as early as January. If some of the animals that were kept for breeders go off-color, it is advisable to eliminate them. After breeding, you will be able to cull the poor or non-breeding animals. In the summer, females that have failed to produce kits, had insufficient milk for their litters, or have passed the maximum producing age can be marked for pelting. In general, sapphires and Aleutians and their combinations should be eliminated after their second year. Other types, such as pastels and darks, may be kept for three seasons if they continue to produce well.

Health and temperament are other considerations in culling. In your day-to-day feeding and care, mark for pelting those animals

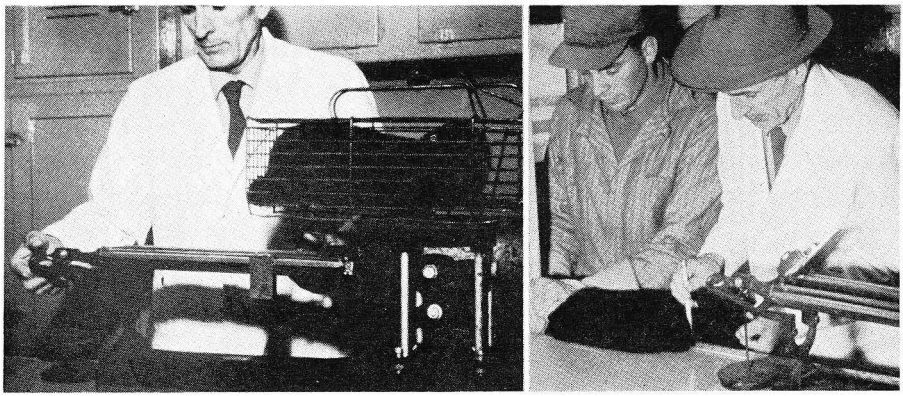
which are chronically thin, have abnormal stools, or mess their nest boxes. Vicious or nervous animals should also be eliminated.

In October and November the animals will be almost full size. At that time mark small animals for culling. Thus, when it comes time to grade your herd for fur quality, many animals will have been eliminated from consideration and you can concentrate on fewer mink from which to select breeders.

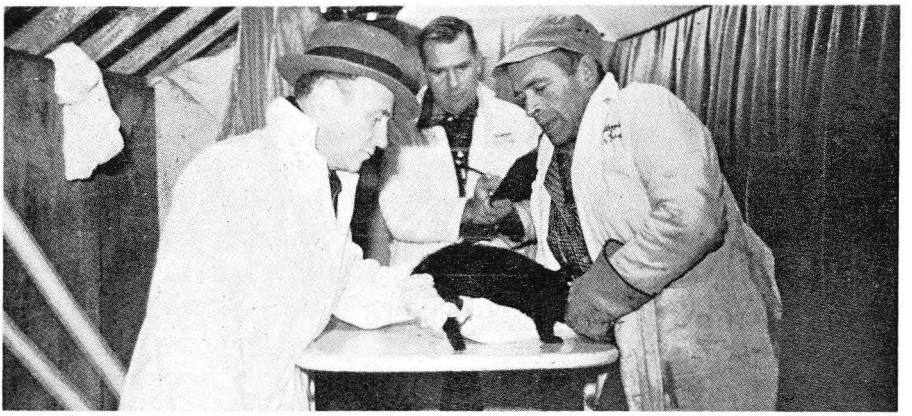
The qualities desirable in breeding animals have been considered in Chapter III. Therefore, only methods of grading will be discussed here. The selection of males is particularly important since each male can usually be mated with four or five females. Thus, males are four or five times as important as females in improving the quality of the herd.

It is easy to look at a group of mink and choose the best animal or the top few. However, the majority of your mink will not be in this class. The most important and difficult job is to pick out those in the medium grades which will most benefit your herd.

In grading mink for breeders, some sort of a guidepost is needed. Select a top mink or two in each color phase and put them in catching or show cages in a place where there is suitable light for judging. Light should be uniform. Reflected light from an undesirable background, such as an aluminum roof or a red barn, will throw off your ability to determine the actual color of the mink. Wear neutral clothing as brilliant colors will also detract from your ability to judge color. Grade mutation mink in the shade. Many ranchers believe



Measuring the weight and the length of mink at periodic intervals helps to evaluate the effects of experimental treatments.



Grading mink at pelting time under standardized artificial light.

that dark mink should be graded in direct sunlight as defects are observable which might not be noted in the shade.

Compare your mink one at a time to the mink which is your standard. If you have enough cages, line up the animals in what you believe is the descending order of their fur quality. A system of recording values is essential if you are going to take advantage of good qualities for herd improvement. The 1x, 2x, 3x grading system used by auction house graders is adequate for determining whether a mink is good or bad. However, for a good breeding program you must know which characteristics of each mink to avoid or accentuate. Use a system that you understand and can make work. A good one is to put characteristics on file cards and grade from 1 to 5, with 1 being the most valuable. The cards show the traits mentioned below:

Mink			Guard Hair				Underfur		
No.	Type	Size	Color	Density	Length	Texture	Color	Density	Length

If the rancher evaluates all animals on the above traits, he should have a good idea on how to improve herd quality in his breeding program.

Pelting represents the final and one of the most important stages in the production of the mink crop. A rancher can no longer influence the size and quality of the mink he has produced. However, he can

needlessly squander much of his profits by haste, carelessness, or ignorance. It is only natural that he will want to begin killing as soon as possible. Food costs, labor in caring for the animals, and the desire to get his pelts on an early market all combine to make him anxious to get the job done quickly. However, premature and improper pelting may lower the pelt value as much as 25 percent. For this amount, it is worth waiting and doing a good job.

It is hard for an inexperienced rancher to tell when his mink are prime and ready for pelting. The development of the pelt and priming of the mink is discussed in Chapter VI. In the latitude of Michigan, priming occurs about Thanksgiving, although it will vary with different years, strains and color phases.

Killing Methods

Several methods are used for killing. A good, safe, simple method is to inject into the heart of the animal a saturated solution (all water will hold) of epsom salts (magnesium sulfate) or a dilute solution of Blackleaf 40 in alcohol. This method is rapid and economical. The principal disadvantage is that it requires two people.

Another method is to use gas. Usually, calcium cyanide is used. Remember that what will kill a mink will also kill a man. Thus treat this operation with considerable respect. The box in which the mink are gassed should be used outdoors. The mink killed with cyanide should be shaken well and allowed to air before they are skinned. Chloroform, carbon monoxide and carbon tetrachloride are also used. If a motor produces the carbon monoxide, take care that the fumes are not hot enough to singe the fur.

If the mink are killed by gas, a practical killing box has about six compartments, each about six inches square and 15 inches long, with sliding doors on the front. A wire screen runs underneath all the compartments and below this is a sliding metal tray. The cyanide is put on the metal tray and the fumes come up through the wire into the compartments.

A simple one-man method that uses cyanide involves the use of a rubber syringe attached to a piece of rubber tubing. The mink is held in one hand and allowed to bite the rubber tubing. As it does, a small amount of cyanide powder is squirted into its mouth.

Breaking the neck by hand is another method. The best way to learn is to watch a skilled person. Once the knack is acquired,

it is not a difficult operation. The male is easy to kill if he is first stunned by tapping him sharply at the base of the skull with a short piece of rubber hose, a precaution not necessary with females. It takes two men to kill males in this manner but people skilled in this claim that it is very rapid and simple. Mink may also be killed by electrocution.

After the mink are killed, they must be allowed to cool. If freshly killed mink are piled together when they are warm, "hair-slipping" will result. This will leave bare spots on the pelt.

Skinning

As described in Chapter IV there is mechanical equipment especially designed for skinning and scraping the pelts. Most pelts are now fleshed on machines. The manual methods are described below.

Equipment for manual skinning includes a sharp knife, a whetstone, pair of side-cutting pliers, forked board or piece of steel for pulling the tail bone, and a tail slicer or linoleum knife for cutting the tail.

Remove the skin while the animal is still warm, or postpone it until the heat is out of the carcass. It is easier to keep the fur free of fat if the carcass is cold. In skinning, make the first cut from the pad of one hind foot to the pad of the other hind foot passing below the vent. Next make a cut on each side of the vent to the base of the tail, leaving a small triangle of fur around the vent. Work the skin around the legs loose and cut off the toes with side-cutting pliers. Work the skin loose around the base of the tail. Pull out the tail bone with the help of a triangular notched board. Then pull the skin away from the body in the manner of peeling off a glove. Pull out the front legs and clip off at the toes. As the pelt is pulled over the head, take care to cut off the ears close to the head and not cut the pelt around the eyes and nose. Next slit the tail the full length. During these operations keep the pelt as free from blood and grease as possible.

Fleshing removes all excess flesh, fat and grease from the hide so that it will remain in good condition until dressed.

Equipment for hand fleshing includes a beam or fleshing board of appropriate size, a scraper for removing the fat from the pelt, and a razor blade or sharp knife.

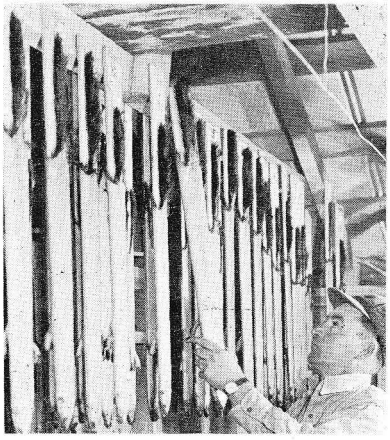
After the pelt is taken from the animal it is usually allowed to cool or freeze before fleshing so the fat will not melt and smear or drip upon the pelt. However in recent years "green fleshing" has become popular in certain areas. In this process, the pelt is fleshed immediately after killing, without the intermediate freezing. Fleshing boards or beams vary in design. Some are set so that the head of the mink faces upward and the mink is scraped from the head downward; some are placed with the head downward so that the mink is scraped from the tail toward the head.

Be careful not to scrape too closely. This exposes roots of the hairs, causing them to loosen, and greatly reduces the value of the pelt.

Stretching and Drying Pelts

After the pelts are fleshed, they are put on drying boards. Standard size boards are recommended by the marketing associations and should be used for uniformity. Pelts are put on the boards with the fur inside. The center of the pelts should coincide with the center of the boards. Place the pelts on the boards so that they are held snugly with very little stretching. Tacks hold the hind feet and tail. The pelts are then put in a cool room (55 to 60°F) and wiped periodically to remove excess fat. After 2 or 3 days, they may be taken off the boards, wiped again and stored on a wire hanger in the same room for several more days. They should then be ready for shipment.

Scraping pelt to remove excess fat.



Drying freshly scraped pelts.

Shipping Pelts

Before shipping, pelts should be thoroughly dry and packed in cartons supplied by the auction houses. Males and females are usually packed separately. Mail an invoice with an accurate accounting of the pelts and marketing instructions to the auction company on the day of the shipment.

Pelts are usually shipped by railway express, air express or air freight. If the rancher has a marketing agreement with an auction company, he insures the pelts for 10 percent of the market value. The auction house insurance policy covers the rest of the value. If no such agreement has been signed, insure for the full value of the pelts.

Handling, Restraining and Shipping Mink

The handling of mink, although not an easy task, can be done efficiently with specially developed equipment. Catching cages are used to move animals from cage to cage or for examinations where handling is not necessary.

In actual handling, always use heavy leather gloves since mink have sharp teeth. A firm grip behind the neck with one hand and at the base of the hips, hind legs, or tail with the other will control the animal.

When it is necessary to pry the mouth open, use scissors wrapped with tape so as not to injure the teeth. There is a special mink tong sold for this purpose which also can be used to hold the mouth closed. Split key rings of various sizes slipped over the nose and held in place by a slender nail placed just behind the canine teeth will also hold the mouth closed.

General anesthetics can be administered if the occasion demands. Nembutal, using the dosage by weight recommended for dogs is satisfactory. Keep the animal warm until the anesthetic wears off. Ethyl chloride may be used as a local anesthetic when treating open sores, such as boils. Mink can be force-fed with a small rubber catheter or an insemination tube.

The rancher should handle his animals for the live fur grader and for the veterinarian during the vaccination program. Mink are generally vaccinated under the armpit of the front legs. Sometimes it is done on the neck forward of the shoulder blades.

Live mink are not difficult to ship providing certain precautions

are taken. They are usually shipped in the fall and winter when heat is not a problem. If the breeding stock you are buying is located within a few hundred miles, it is best to pick them up yourself. They can be carried in shipping crates in open trucks if they can be kept dry and there is no problem of heat. Otherwise ship by railway or air express. These agencies care for the animals en route. They can be feed ground beef during the trip.

When using a common carrier, your mink may be exposed to other animals and thus carry diseases to the ranch. You should isolate new animals as discussed in Chapter IX.

IX. SANITATION AND DISEASE

This section discusses sanitation and disease prevention practices which may help to control disease on your ranch. While it is not a comprehensive survey of mink diseases, symptoms of those that commonly affect mink are described. Thus you may recognize them at an early stage and take the proper control steps for a minimum of loss. Often, control will require the help of a veterinarian. However, the sooner the symptoms are recognized, the easier it will be to get proper help.

In Michigan, two sources are available besides your local veterinarian. They are the Diagnostic Laboratory, Department of Veterinary Pathology at Michigan State University, East Lansing, and the Control Laboratory, Michigan Department of Agriculture, 1615 S. Harrison Road, East Lansing.

How Diseases Spread

To understand the reasons behind disease prevention practices, let us consider how diseases and infections are spread. As might be expected, direct contact is a common means. Since mink are caged separately during most of the year, contact spreading is less common than among other domestic animals. However, during the breeding season and when kits are young, diseases may be spread in this manner.

Diseases may also be spread through indirect contact. Body secretions from one animal are transferred to another by feeding spoons, scrapers, or clothing of the caretaker. Feed trucks, salesmen or vis-

iting ranchers may also be an indirect source. Diseases can be carried by flies, dogs, cats, rats, mice and birds. This is a good reason for keeping them away from the mink yard. It is not common for mink to contract diseases through the water supply but some may be carried through its food. Also, when the animal's resistance is lowered, certain bacteria already within the body may become pathogenic, i.e., they may cause disease. Of little importance are soil-borne infections, infections carried through the air and those from insect bites. Poisons and the harmful effects of certain management practices will be discussed later. With the above background, let us consider good management practices for preventing the outbreak and spread of disease in mink.

Preventing Spread of Diseases

A primary consideration is *ranch location. Poor drainage* may lead to spread of disease. *Construction* of pens and nest boxes so that they are easy to clean reduces potential hazards. By raising the animals on wire, parasites, which would normally be a problem to mink, are prevented since many parasites spend part of their life cycle in the ground. A good animal-proof guard fence helps prevent disease by keeping out stray animals (as well as preventing the escape of valuable mink.)

The *quarantine* of sick mink, newly purchased animals, and mink that have been brought back from shows also helps prevent disease spread. Keep such animals in a separate shed for five or six weeks. Put on rubbers when entering the isolation area and remove them when leaving so as not to spread disease agents. Also use separate food and water containers.

Proper *disposal of dead mink* is important. Mink that die and are not submitted for autopsy should be buried or burned before flies, rats or other animals come in contact with them.

Practice *sanitation and cleanliness* in the mink yard as well as in the feed room. Remove droppings from the pens and the ground underneath the pens frequently.

The feed room should be designed for easy cleaning—and thoroughly cleaned regularly with a disinfectant. Use commercial cleaning compounds according to the manufacturers' instructions. Steam, in combination with a good cleaning compound, is excellent for cleaning and sanitizing.

CHART 3—Symptoms, prevention and control of mink diseases

DISEASE (Cause)	ANIMALS AFFECTED	SYMPTOMS	CONTROL	
			PREVENTION	TREATMENT (See veterinarian)
Distemper (Virus)	All, kits more susceptible	Reddening of skin around ears, nose, chin and feet, becoming swollen, dry and scaly as disease progresses. Eye and nose discharge	Vaccinate all breeders; all kits in July	Separate all sick mink from herd. Vaccinate immediately. Some veterinarians recommend killing sick animals.
Virus enteritis, Fort Williams disease	Mainly kits. Usually from July-Oct.	Animal misses feed. Casts or "slugs" in droppings; grayish-white to pinkish bloos in feces late in disease	Vaccinate if disease is in your area or if on your ranch previously	Isolate animal and pen. Vaccinate
Aleutian mink disease	Mink related to Aleutian	Loss of weight, loss of appetite, black droppings, some bleeding at mouth, thirst, death	None	None
Salmonella (Bacteria)	All—much variation	Black, tarry droppings. Loss of weight, may cause abortion	Clean ranch, fresh, cold feed	Certain sulfa drugs. Change feed
Non-specific enteritis (Bacteria)	All—usually in warm weather	Mink refuse to eat. Symptoms may be intermittent. Feces may be light and mucoid or black	Good sanitation	Antibiotic
Anthrax (Bacteria)	All. Will also affect humans	Bloody foam from mouth and nose. Blood from anus. High temperature. Refusal of food	Avoid feeding meat from questionable sources	Consult veterinarian. This disease is very dangerous to humans
Botulism (Bacteria)	All	Dead and paralyzed mink in 10-96 hours. Eyes bright, partial or complete paralysis, labored breathing	Vaccination with toxoid. Fresh cold feed	Polyvalent antitoxin, often unsatisfactory
Boils, abscesses, cysts (Bacteria plus sharp food particles or bedding)	All	Swellings around head or neck which break open. Lack of appetite	Careful selection of nesting material. Do not feed meat from animals that had strangles or fistula of withers	Remove fur in area. Lance and wash. Antibiotic
Tuberculosis (Bacteria)	All	Gradual loss of weight, distension of abdomen, watery eyes, nasal discharge	Do not feed animals affected with tuberculosis	None

Tularemia, rabbit fever (Bacteria)	All, will also affect humans	Loss of appetite, fever. Lassitude, death in one or two days	Procure rabbits after frosts. Do not feed rabbits with spotty livers	Consult veterinarian. This disease is dangerous to humans
Pneumonia (Bacteria)	Associated with wet, damp weather or temperature change	Lack of appetite, labored breathing. May be discharge from eye or nose	Keep nest box dry and properly ventilated.	Antibiotics or sulfa drugs. Treatment is difficult
Coccidiosis (Protozoa)	All—usually June-Sept. Kits most susceptible. Now rare	Animals stay in nest box. Feces coated with mucous. Appetite poor. Coat ragged.	Wire bottom pens. Remove droppings	Treatment is difficult. Prevention is best treatment
Flesh flies (Larvae of flesh-eating Wohlfartia flies)	Kits mainly	Small wet holes in skin of kit. Serum exudes. Fur matted. Lack of appetite	Fly sprays and traps. General sanitation measures. Keep orchards and early flowering crops away from ranch	Squeeze area open and pick out larvae with forceps. After removal, disinfect.
Bladder stones, calculi, urolithiasis (bacteria, stilbestrol plus unknown causes)	Mostly pregnant and lactating females, kits in summer	Often none. May be dribbling of urine, loss of appetite, weakness of female at time of birth of young. Urine bloody tinged	Altering acidity of urine by adding phosphoric acid or ammonia chloride to food	None
Wet belly, acidosis (unknown)	Mostly male kits	Dribbling of urine. Unthriftiness. Loss of weight	Sometimes appears to be related to high fat level, or rancidity	Fresh liver, fresh feed, diet low in fat
Steatitis, yellow fat, watery hide disease. (rancid feed and lack of vitamin E)	Usually only young growing mink (July-August)	Appears without warning. Large kits found dead. Peculiar unsteady hop. Mink flatten themselves out on wire	Do not feed rancid feed. Be sure vitamin E level is adequate. Antioxidants	Add vitamin E or wheat germ
Nursing sickness (Nutritional, lack of salt)	Nursing mothers—June-July	Mothers very thin, weak. Refuse to eat. Kits hungry	Plenty of good fresh food and water. Get kits eating as young as possible. Be sure salt level is adequate	Same as prevention
Rickets (Lack of vitamin D, calcium or phosphorus)	Mainly young. Now rare	Bow legs, bent outward, small size	Sufficient vitamin D, calcium, phosphorus and sunlight	Add vitamin D, Ca, P supplement and sunlight
Chastek paralysis (Thiamin deficiency)	All	Loss of appetite, gradual loss of weight, convulsions, paralysis	Cook fish, or feed on alternate days, if they contain thiaminase	Feeding or injection of vitamin B_1
Cotton pelt (Faulty iron metabolism, exact cause unknown)	Mainly kits	White underfur, poor growth, anemia	Do not feed high levels of raw hake or whiting or cook them	Same as prevention
Grey diarrhea (Cause unknown)	All. Mainly in summer	Weight loss, large appetite, grey droppings	Do not breed these animals or their relatives	Nitrofurazone, reduce dietary fat
Heat exhaustion (Excessive prolonged heat)	All—mainly lactating females and young kits	Kits quiet. May appear nervous, rapid breathing, staggering, saliva at corners of mouth, convulsions and death	Good air circulation, water often, burlap bags on pens, open lids of nest boxes, take hay out of nest box	Kits at whelping almost untreatable. Older kits revived by dipping in lukewarm water and placing in good air circulation

Chart 3 on mink diseases is based on the literature and is a guide to the early recognition, symptoms, treatment and prevention of common diseases. It does not include all mink diseases—nor is it intended to take the place of the veterinarian who is experienced with mink.

Where a veterinarian is unavailable and the number of animals small, some ranchers provide unthrifty animals with food specially enriched with vitamins, minerals and antibiotics; they may place particularly sick animals on the ground on grass where they can be easily observed.

Poisoning

Harm may also come to mink from poisoning. Sulfaquinoxaline controls parasites or other disturbances of the digestive tract of domestic animals. However, it is not recommended for mink because it upsets normal bloodclotting. Streptomycin also may have harmful effects. An overdose can kill a mink within a short period of time.

Wood preservatives and disinfectants of the creosote and chlorinated phenol types should not be used where they come in contact with mink as these substances are poisonous, particularly to young mink. Wood preservatives inside the nests may be toxic to mink even after a period of years. Flea powders, such as the derris (rotenone) type, should not be used during the whelping season. Mink are quite susceptible to lead poisoning which consequently should be kept away from surfaces which they will touch. Warfarin, used as a rat poison, is also toxic. The dangerous effects of some feed additives and stilbestrol have been considered in Chapter VII.

Vaccination

Vaccination can prevent three diseases—*distemper, botulism* and *virus enteritis.* Good practice calls for vaccination for distemper and botulism. The advisability of vaccinating for mink virus enteritis depends on local conditions.

Distemper vaccination is usually carried out in the breeding herd after pelting, and in the kits at weaning.

Vaccination for botulism is carried out with a toxoid-type vaccine. Botulism toxoids and living chick embryo distemper vaccine can be given to the mink at the same time if manufacturers' in-

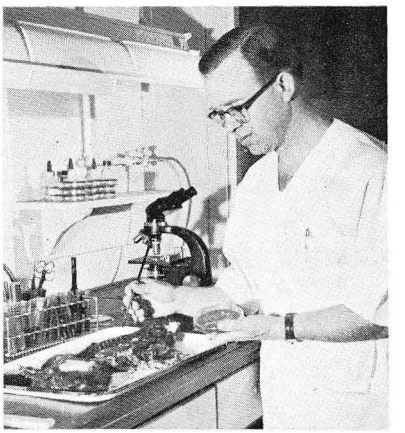
structions are followed. Some inject the two vaccines in different locations; whereas, others give both with a single syringe and injection.

Mink are usually vaccinated for mink virus enteritis in late June or early July. Whether or not it pays to vaccinate depends upon the prevalence of the disease in your area. If it has been present on your ranch in previous years, has been found in your area, or there is reason to believe your mink might be exposed, it is wise to vaccinate.

Laboratory Diagnosis

Since many veterinarians are not familiar with mink diseases and do not have facilities for laboratory diagnosis, it is often necessary to ship specimens for laboratory diagnosis. For the pathologist to diagnose disease, he must receive properly preserved material. Thus it is to your advantage to see that the specimen you send arrives in good condition.

The best way is to take sick animals, or animals that have just died, to the laboratory yourself. If you must ship an animal, select one that has just died and put it in the cooler immediately. Decomposition must not have started or it will be useless to ship it. Most laboratories prefer to have cool but not frozen specimens. The mink can be put in a small water-tight container inside another larger container with ice between them. Then the whole box should be well packed with insulation such as shavings, sawdust, excelsior, or sugar cane bedding.



Taking bacterial culture to determine cause of death.

Another method to preserve the specimen during shipping is as follows: Select a small can with a water-tight screw top and partially fill it with water. Put in the freezer and when the water is frozen screw on the top. Place the can in direct contact with the animal. Wrap 20 or 30 layers of newspapers around the container and dead mink to supply insulation.

A complete history of the disease should accompany the specimen. In fact, the history is more useful than the carcass in some instances. It should include the following: number of animals on ranch, number sick, number dead, age of affected animals, color mutations affected, dates of first and later losses, description of symptoms, feeding schedule giving percentages and kinds of feed, recent changes in feeding schedule, where the disease occurred (in one shed or over the ranch), treatment given (if any), type of housing, whether or not animals are on wire or on the ground, whether or not any other ranchers in the area are having difficulty, and any other information that you believe might be of help. If the pathologist has this information, plus a typical specimen which arrived in good condition, he should be able to make an accurate diagnosis.

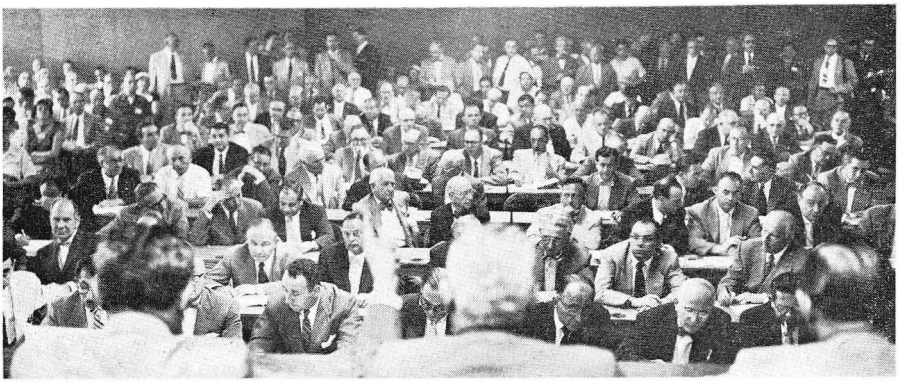
X. MINK ASSOCIATIONS, MARKETING ORGANIZATIONS AND LIVE MINK SHOWS

Several types of organizations work for the welfare of individual ranchers. The ranchers in turn should support them, both for their own benefit and for the general prosperity of the mink-farming industry. These associations have different purposes or functions and most ranchers belong to several.

Nationally, there are organizations which deal with legal problems, general welfare, research, advertising and marketing. On the state and regional levels there are associations which act as clearing houses for information on mink problems. In certain local areas, there are feed-buying and mixed-feed cooperatives.

The National Board of Fur Farming Organizations, 152 W. Wisconsin Ave., Milwaukee, Wisconsin, is composed of representatives of the various state and regional groups, as well as certain large ranchers. This organization compiles statistics and attempts to promote the welfare of the industry. It keeps governmental agencies and others informed on matters of concern to mink farmers.

The Mink Farmers Research Foundation, 152 W. Wisconsin Ave., Milwaukee, Wisconsin, is a non-profit organization whose purpose is to promote and support research on ranch mink. Officers are non-salaried and receive no expenses, so that all funds received are used for research. The Foundation has helped to underwrite research on Aleutian disease, fur fiber, arsanilic acid, gray diarrhea,



Auction sale of pelts in progress.

use of menhaden meal, virus enteritis, amino acid requirements, supplemental methionine, wet belly, vitamin A and E deficiencies, antioxidants, dietary fat levels, radioactive tracers in fur, blood components of certain genetic color phases, "cotton pelts", "hippers", flesh flies, urinary calculi, thiamine and riboflavin requirements, stilbestrol and botulism.

Funds for this association come from certain marketing associations which contribute a small amount annually for each pelt handled. Grants are usually made to state or federal agencies to encourage and help finance research in areas of interest to the mink rancher.

There are many regional, state and local organizations in the United States which help ranchers through educational programs, field days, live animal shows, and act as convenient sources of information on industry activities. Michigan has two such organizations, the Michigan Fur Breeders Association and the Upper Michigan Mink Breeders Association.

Most ranchers sell their pelts through member marketing associations which they join. Mutation Mink Breeders Association (EMBA), Racine, Wisconsin, represents most of the mutation producers. It is an *open* membership association. The Great Lakes Mink Association (GLMA), Kenosha, Wisconsin, has open membership from the entire country—not only from the Great Lakes area. It handles all types of pelts and provides ranch veterinary service to its members. The United Mink Producers Association (UMPA), Janesville, Wis-

consin, has *closed* membership by election. It is the oldest and smallest association, and is composed of the larger producers of dark mink only.

The associations introduce, promote and merchandise the pelts of their members and maintain minimum standards for the quality of the skins sold under their registered trademarks. Trademarks under which EMBA pelts are retailed are given in Table 9. They select sales dates, and supervise grading, lotting and selling of their members' skins in conjunction with the auction companies. Activities are financed by a small deduction from the selling price of the member's pelts, paid directly to the associations by the auction companies. The associations promote consumer demand through advertising and also aid in orderly marketing through controlling the rate at which the annual crop is fed into the market. Thus they perform services which ranchers could not hope to accomplish as individuals.

Over four-fifths of the annual crop of mink skins is sold by auction. The remainder is sold at the ranch to dealers and brokers or directly to manufacturers. The value of selling by auction is that it allows buyers from throughout the world to bid for your pelts. More than most commodities, pelts vary because of slight differences in color, density, nap, etc. Competitive bidding helps establish their true value. Small collections of pelts are combined

Dressed pelts being graded and placed in bundles of equal quality before being placed on display for inspection by potential buyers.

*TABLE 9—EMBA Trademarks**

Trademarks (colors)	Type of mink
AUTUMN HAZE (brown)	Pastel Royal Pastel Greeneye Pastel Dawn Pastel Ungava Moyle Buff
DESERT GOLD (Light Brown)	Topaze
ARGENTA (Grey)	Silver Blu Steel Blu
CERULEAN (Blue)	Sapphire
LUTETIA (Gunmetal)	Aleutian Iris
AZURENE (Pale Grey)	Homozygous Winterblu Homozygous Platinum Homozygous Sapphire Violet
JASMINE (White)	Dominant White Hedlund Recessive White Regal White
TOURMALINE (Pale Beige)	Pearl
ARCTURUS (Lavender Beige)	Hope Lavender
DIADEM (Pale Brown)	Palomino Perrin Buff Colton Beige
AEOLIAN (Grey Taupe)	Heinen Buff

**The EMBA trademark is applied only to prime pelts which meet the quality standards established by MMBA. All mutation pelts of inferior quality are sold at the end of each catalog under the common type name without trademarks.*

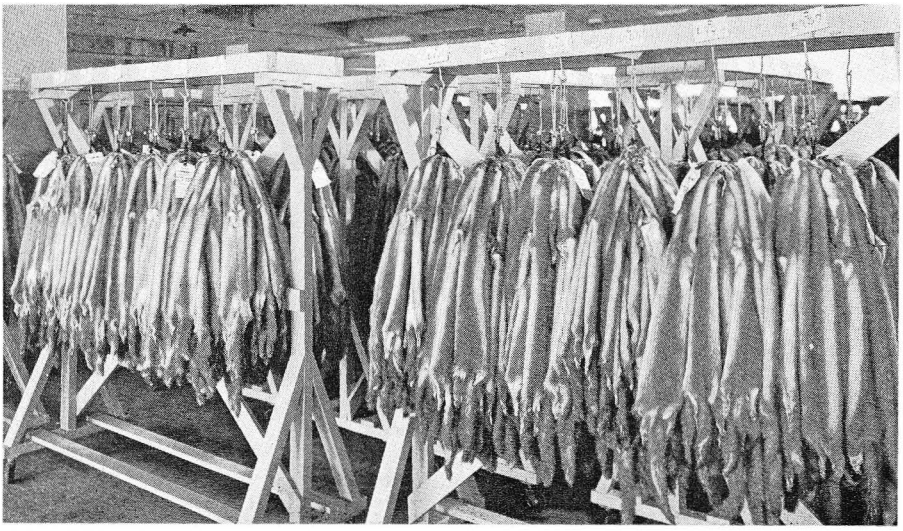
by the auction companies into larger-sized, well-matched bundles more desired by the trade. This is called "part-lotting" and brings higher prices.

Auction companies also provide ranchers pelt insurance (30 days from date of slaughter), consignment invoice forms, shipping cartons, cash advances against pelts received prior to sale, and valuations as a guide in selling. The companies charge five percent selling commission. New York City is the fur marketing center of the United States. Auction houses there have sold two-thirds of the output in recent years, but sales are also held in Minneapolis, Seattle, and Milwaukee. Buyers are manufacturers of fur finery as well as brokers, dealers and exporters.

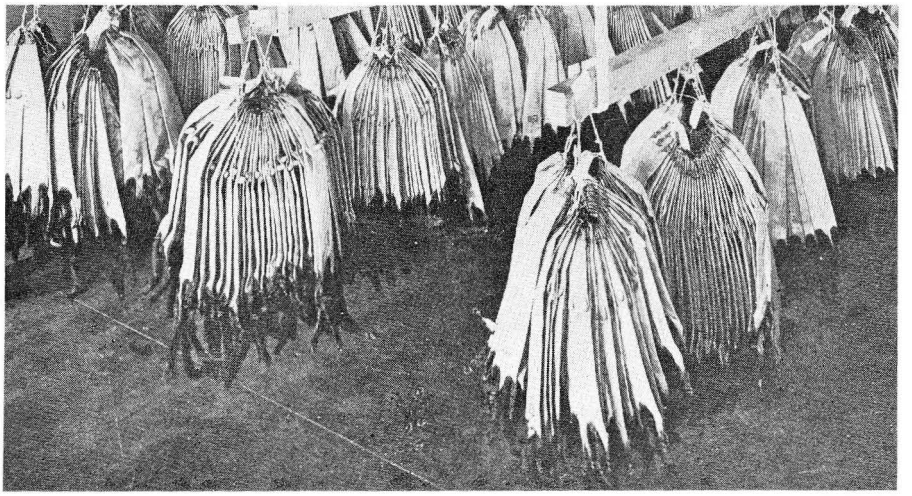
Natural dark skins, as well as early offerings of certain mutations are sold in the undressed condition. Most mutations are sold dressed. Some ranchers specify how they want their skins sold—raw or dressed; others let the auction companies decide. The latter will arrange for the dressing of the raw skins if desired.

Some fur auction houses that have serviced the ranchers for many years are:

Hudson's Bay Company, 151 W. 30th Street, New York, N. Y.
New York Auction Company, 226 W. 26th Street, New York, N. Y.
New York Auction Company, 123 Third Street, Minneapolis, Minn.
Seattle Fur Exchange, 1008 Western Avenue, Seattle, Washington

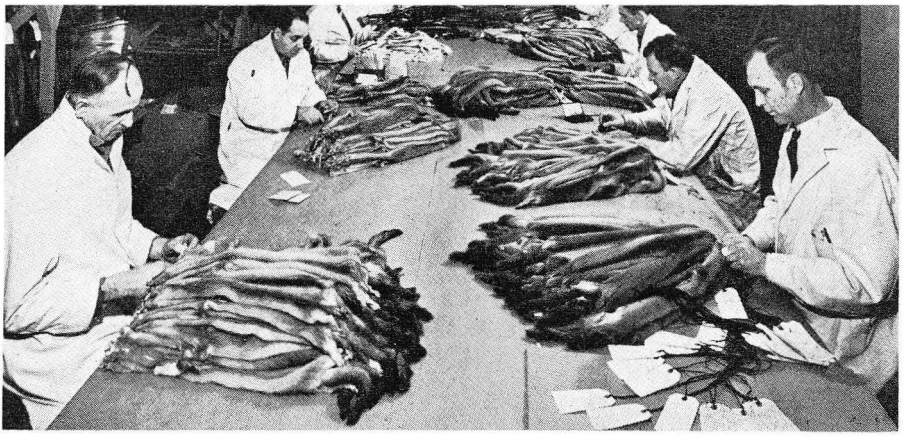


Dressed pelts on display for inspection by potential buyers before auction.



Raw pelts on display for inspection before auction

Live mink shows have been held in the United States since 1929. The shows are very important to the industry because they publicize the new characteristics bred into the animals and thus help the breeders get desirable strains into large-scale production. Over the years, such desirable characteristics as "extra-dark" "short nap", etc., as well as the various mutant colors have been introduced. Live shows also make known undesirable characteristics, such as "off color", etc., and help to eliminate them. Recently, mink shows have been held annually in certain northern and western states;



Dressed pelts being recorded to identify their owners.

the International Mink Show is held in January in Milwaukee, Wisconsin.

XI. WHERE TO GET MORE INFORMATION

Much practical information is found in booklets distributed by many mink food and equipment companies, state and government agencies, and marketing associations. The following cover aspects of mink ranching that go beyond the scope of this bulletin. It is only a partial list and no discrimination is intended against those which have been omitted because of lack of space.

Guide Books on all Phases of the Industry

Blue Book of Fur Farming. Editorial Services, Inc., 1712 W. St. Paul Avenue, Milwaukee 3, Wis. (Official publication of the International Mink Show held yearly in Milwaukee, Wis. Sections written by specialists; revised annually.)

Fur Farm Guide Book. Fur Farm Publications, 405 E. Superior Street, Duluth 2, Minn. (Written by the editors of the *American Fur Breeder* magazine and others. Also summary and condensation of articles that have appeared in this magazine.)

Fur Farming Journals

American Fur Breeder, 405 E. Superior Street, Duluth 2, Minn.

Fur Trade Journal of Canada, 588 Mt. Pleasant Road, Toronto, Ontario, Canada

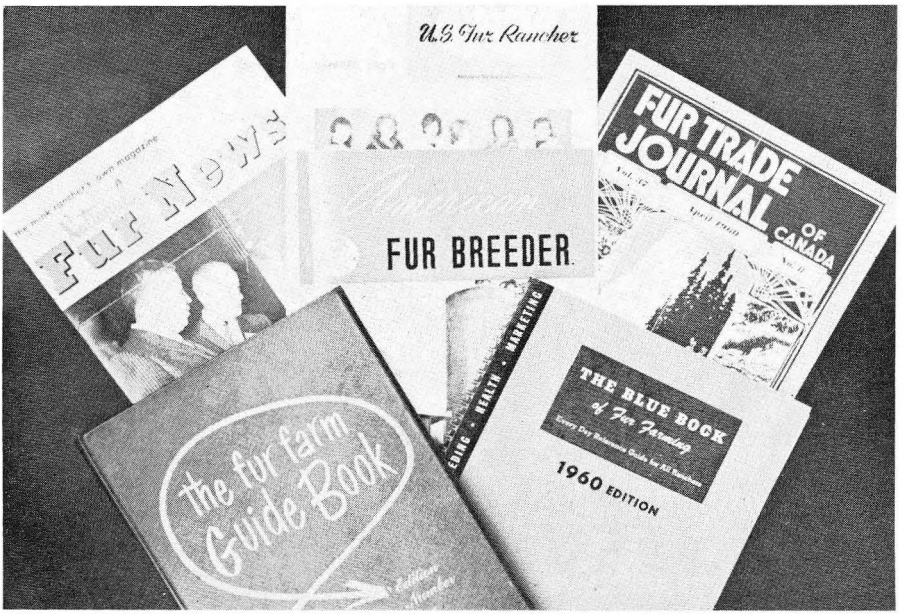
National Fur News, 200 Clayton Street, Denver 6, Colo.

U. S. Fur Rancher, Editorial Services, Inc., 1712 W. St. Paul Ave., Milwaukee, Wis.

These monthly journals contain articles of current interest on mink and allied subjects. Breeding stock, as well as food and equipment, used by mink ranchers are advertised.

Breeding and Reproduction

Genetics of the Ranch Mink. R. M. Shackelford, Pilsbury Publishers, Inc., 10 West 33rd Street, New York, N.Y. 1957. (Standard reference on color phase genetics.)



A trade journal can be a source of helpful information for the mink rancher.

Reproduction in Mink. R. K. Enders, Proc. Am. Phil. Soc., Vol. 96, No. 6, Philadelphia, Penn. 1952. (Technical monograph on physiology of reproduction.)

The Physiology of Reproduction in Mink. A. Hansson, Bonniers Boktryckeri, Stockholm, Sweden. 1947. (Technical monograph on physiology of reproduction.)

Sperm studies in breeding practices. Bul. AGD-111, USDA, Washington 25, D.C. (This tells how to make sperm checks on mink.)

Feeding and Nutrition

Nutritive Requirements for Foxes and Mink. National Research Council, Washington, D.C. (Report giving tentative nutritive standards based on presently available knowledge. Revised from time to time.)

Animal Nutrition. L. A. Maynard and J. K. Loosli. McGraw-Hill Book Co., New York, N.Y. (General fundamentals of animal nutrition, not specifically mink.)

Feeds and Feeding. F. B. Morrison, Morrison Publ. Co., Ithaca, N. Y. (Practical feeding and nutrition of farm animals, not specifically mink.)

Diseases

Minks: Diseases and Parasites. Agriculture Handbook No. 175, USDA, Washington 25, D.C.

Mink in Health and Disease. A. H. Kennedy. *Fur Trade Jour. of Canada,* Toronto, Ontario, Canada.

Keeping Livestock Healthy. 1942. Yearbook of Agriculture, USDA, Washington 25, D.C. (Extended discussion of various diseases of mink and livestock.)

Fur

Advanced Fur Craftsmanship. Samuel Raphael. Fur Craftsmanship Publishing Co., 255 7th Avenue, New York 1, N.Y. (Mechanics of making finished garments.)

Fur. Max Bachrach. Prentice-Hall, Inc. New York, N. Y. (Furs with respect to species and geography. Chapter on peltries.)

The Molting and Fur Growth Pattern in the Adult Mink. C. F. Bassett and L. M. Llewellyn. *The American Midland Naturalist,* Vol. 42, No. 3, pp. 751-756, November, 1949. The University Press, Notre Dame, Indiana. (Discusses progressive development of summer and winter coats.)

Priming-up of Hair in the Mink. 1959. Ethel H. Dolnick. *National Fur News.* Vol. 31, No. 10, pp. 20, 66. (Describes changes in the hair and skin during the priming process.)

Histogenesis of Hair in the Mink and Its Relationship to Dermal Fetal Fat Cells. 1959. Ethel H. Dolnick. *Journal of Morphology,* Vol. 105, No. 1, pp. 1-31. (Technical article on the development of the hair follicle.)

General Industry

Mink Skins. Sept., 1959. U.S. Tariff Commission, Washington 25, D.C. (Report of investigation of domestic mink production and imports.)

Reports on projects of Mink Farmers' Research Foundation, Milwaukee, Wis. (Annual reports of progress on projects supported by Foundation grants.)

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