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Nutrition and Management of Reproduction in the Cat

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The successful long-term maintenance of catteries for reproductive purposes necessitates careful consideration of many facets of feline health, nutrition, and management. Control of infectious and parasitic diseases, proper nutrition and feeding, management of reproduction, and general management procedures are key activities. In this article these topics will be reviewed and recognized practical methods will be discussed. The concepts presented in this article are general ones. Application in individual catteries requires thought and planning. Considerable variability will be found in practice in the actual implementation of many of the ideas discussed.

GENERAL MANAGEMENT CONSIDERATIONS

The precise conditions under which catteries are maintained will be found to vary widely. However, awareness of some general concepts will enable the clinician to be very effective in helping to recognize and solve management-related problems. For those facilities where environmental control within defined limits is required, recommendations have been published.^{1, 24, 58, 63, 67}

Under most circumstances, wide fluctuations of temperature and humidity in a cattery tend to be conducive to increased upper respiratory disease. This can be particularly true in facilities that may be overcrowded or those with a constantly changing population. Excessively dry or damp environments should be avoided. Loud noises should be minimal, and other species should not be concentrated in immediate proximity to a cat breeding facility.

Animal handling (feeding, cleaning, examinations) should be conducted

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Table 1. *Desirable Properties for a Disinfectant*

Nonirritating	Good penetration and surface activity
Nontoxic to animals and man	Not corrosive to floors, walls, and objects in the environment
Wide spectrum of microorganism-killing activity	Chemically stable
	Relatively inexpensive

on an age-priority basis where practical, with the youngest kittens being handled first, followed by weaned kittens, and progressing through successively older adult groups of cats. Among adult cats, pregnant queens should be handled first. This also helps to maintain barriers established by life-stage segregation of cats if this is the practice.⁶⁰

If a cat is suspected to be ill, it should be isolated outside of traffic patterns and veterinary examination and treatment obtained at once. It is wise to provide a separate area for this purpose, if possible.⁶⁰ In small catteries, these procedures may be unnecessary or impossible, but this does not negate the need for strict attention to good sanitation practices.

Designing and maintaining effective sanitation procedures are activities worthy of consideration, for the sanitation program plays an important role in the overall health of the cattery. Proper sanitation involves more than simply choosing a particular cleaning or disinfecting product, but the clinician does not have to be a chemist or a microbiologist to establish programs to maximize the effectiveness of such products. Recognition and application of a few practical principles and precautions will greatly enhance these as well as other health maintenance efforts (Tables 1 and 2).^{36, 55, 57}

Table 2. *General Principles of Disinfection*

1. "Elbow grease"—There is no substitute for good physical cleaning (sweep, wipe, mop, vacuum).
2. Organic matter—Lowers the effectiveness of many disinfectants.
3. Chemical combinations—Combinations of some soaps and some disinfectants are chemically inappropriate and can result in loss of effectiveness. Rinse *thoroughly* in between sequential applications.
4. Surface—Location and material. This is especially important for certain products with regard to corrosiveness and cost.
5. Dissolved mineral content of hard water lowers effectiveness of some products.
6. Contact time for maximum killing of susceptible microorganisms. Follow manufacturer's directions *exactly*.
7. No "clutter"—Surfaces, cabinets, and drawers should be clean and orderly. Minimize stored objects and be sure they are always clean. Accessory cleaning equipment, especially vacuums, must be clean and sanitary also.
8. Limit access of insects and rodents.
9. Monitor the environment (that is, bacterial, fungal cultures).
10. Regular schedule—A schedule should be written and followed. Assign specific individuals to specific tasks. Multiple repetitions per day may be necessary in unusual situations.

For the interested clinician, an extensive discussion of antiseptics and disinfection is available.³¹

The actual choice of a disinfectant can be a somewhat bewildering experience, as numerous products are readily available. Fortunately, many disinfectants in common use today will fall into one of just a few general classes: quaternary ammonium compounds, phenolics, halogens, biguanides, and dialdehydes.³⁸

When choosing or recommending a disinfectant product, the clinician should first know its classification and the chemical properties of that class, as well as the advantages and potential disadvantages of such products.^{38, 55, 57} Within a particular class of compounds, there may also be some differences among products. For example, many iodine preparations have good activity against feline rhinotracheitis virus, but their activity against feline calicivirus can vary.⁵⁷ The clinician must be aware that no single product will address all problems and be completely suited to every environment.^{38, 55, 57} The types of microorganisms that are important in a specific cattery must be known, so that a disinfectant with good activity against this (these) organism(s) can be chosen and applied.^{38, 55, 57} Finally, and most important, the agent chosen must be safe around cats, and manufacturers' directions must be followed exactly. More is not better where corrosion or toxicity might result. It is prudent to periodically check the disinfectant being used for activity against microorganisms known to be present. This can be accomplished in many microbiology laboratories.

Before recommending a change in disinfectants, the clinician should ascertain whether the operators of a facility are using their disinfecting agent correctly and whether other aspects of the management program are adequate (see Table 2). The identity of any offending microorganisms must be known if such a change is to be effective.

Routine daily cleaning procedures will vary with the type of facility and housing. In general, daily waste disposal, avoidance of clutter, and attention to possible sources of fomite contamination are important and will greatly enhance the ease of day to day cleaning. Cattery operators should be reminded to remove potential sources of insect and rodent entry and breeding. Care should be taken to avoid exposing cats directly to detergents or disinfectants. Usually, this can be accomplished simply by ensuring that cages or rooms are dry after cleaning and before replacing cats.

Depending upon the facility, the veterinarian might encounter many different types of caging materials. Poorly maintained cages or pens not only present an injury hazard but may more easily harbor insects or infectious agents. Wood requires effort to maintain, as does fiberglass if a cat scratches the surface excessively. Even aluminum can sometimes be pitted by cat urine. Good-quality galvanized metal or stainless steel cages cost more initially but are easier to maintain and last longer.

When cleaning larger areas, it should be remembered that wide fluctuations in temperature and humidity are not desirable; therefore, appropriate attention to ventilation is indicated.^{1, 46, 48, 58, 60, 63, 67}

Litter pans should be emptied, washed, disinfected, and changed as often as is required to maintain a clean environment, even though this may be labor-intensive. Feed pans, water bowls, and other utensils should be

handled similarly. Disposable feed and litter pans are a useful alternative in many situations and may be more suitable for random source or high turnover facilities. With signs of illness, or with a changing cat population, these procedures are particularly important. Employees' hands should be thoroughly washed between cages or pens or when handling ill cats. Fresh water must be continuously available and should be examined periodically for potential pathogens.

Food management is another aspect of sanitation. Unopened bags of food should be stored off of the floor and away from the wall, about 18 inches in each direction. It is important to clean under, behind, and between storage structures daily. Easy access will assure that this will be done as required. Metal or wood shelves are adequate. Wood requires more maintenance, but some disinfectants hasten the deterioration of metals also. Environments with high temperatures and humidity are undesirable for food storage.

After opening, bags of food should be placed in waterproof containers with tight-fitting lids. It may be advantageous to elevate these containers several inches from the floor. These measures will help prevent rodent and insect contamination if a facility is located where this could occur. The food storage area should contain only food. Other utensils and equipment should be stored elsewhere.

Insect and rodent control measures should include elimination of hiding places and ready food sources, as well as prevention of their access insofar as is possible. Where baits or insecticides are used, animal and human safety must be considered.

The sanitation program is an integral part of the activities of a feline colony and is a valuable adjunct to other health and general management procedures if correctly employed. A chemical agent is not a substitute for proper management procedures and will not "cover up" other errors in management for very long.

Although discussion of these simple and long-recognized procedures may seem to be mundane, a surprising number of facilities, both large and small, expend considerable sums on sophisticated equipment, breeding programs, and research, and experience difficulty because very basic sanitation is not diligently pursued.

ISOLATION

Critical to the continued integrity of a feline colony is the isolation of new arrivals. Today, this is a well-accepted concept of animal management. Entering stock should be as few in number at any one time as is feasible. They should be isolated for a minimum of 30 days as far away from colony residents as possible, with attention to the prevention of either direct or indirect contact between residents and incoming stock. These measures may be impossible in small facilities. In this event, thorough veterinary examination, including all available historical information, is imperative prior to entry of new residents.

The isolation period affords the opportunity for close observation and

Table 3. Minimum Routine Laboratory Profile for Breeding Cats

Complete blood count with differential WBC count	Calcium
Glucose	Phosphorus
BUN	Sodium
Creatinine	Potassium
ALT (SGPT)	Chloride
Alkaline phosphatase	Complete urinalysis
Total bilirubin	Fecal flotation(s), direct smear(s)
Total protein	FELV test
Albumin	Toxoplasmosis titer

for multiple physical and laboratory examinations to evaluate individual health, behavior, or other problems that would make the subject unsuitable for breeding or for in-colony maintenance generally. This period also permits the administration of wormers, vaccines, and other appropriate surveillance procedures. The clinician should be sure that an isolation area for incoming stock is not being used for the isolation of colony residents during periods of illness. These simple procedures, if applied with diligence, will help protect the resident population.

THE HEALTH PROGRAM

Successful health maintenance in any animal reproduction facility necessitates preventing the introduction and dissemination of diseases. Once infectious diseases become endemic in the colony, control measures can be expensive and frustrating.

In a breeding colony, all cats should receive a complete physical examination and a minimum laboratory profile on an annual basis (Table 3). Only healthy cats should be used for breeding. Vaccination status of breeding cats should be determined prior to mating and should be updated if necessary. In problem catteries, early weaning and modified vaccination schedules may be employed.² Intranasal respiratory vaccines may be considered as a part of such a program.² Although signs of respiratory infection may occur in almost any cattery, well-managed facilities should experience this problem only in individuals or small groups, with short duration, mild illness, and rapid recovery being the rule.

Fecal examinations should be conducted on all litters at or prior to weaning, depending upon the clinical history of the facility. The adult breeding population should be screened periodically as well, even with a stable population.

The clinician should be mindful that some parasites may require repeated examinations or special techniques for diagnosis. Particularly in random-source or overcrowded facilities, or facilities where surveillance has not been practiced, the clinician must maintain a higher index of suspicion for parasites that might not be actively sought on a routine basis. These

parasites include *Capillaria*,^{25, 44, 69} *Giardia*,^{10, 37, 69} *Platynosomum*,^{5, 8, 29} *Cytauxzoon*,^{22, 68} *Toxoplasma*,^{11, 14, 39, 69} *Paragonimus*,^{30, 51, 69} *Ollulanus*,^{24, 26, 27} *Hepatozoon*,¹⁵ and *Aelurostrongylus*.^{17, 42, 47, 69} Recent reports should also make the clinician aware of the possibility of *Dirofilaria*^{13, 23, 70} or *Cryptosporidium*^{6, 32, 49, 50, 61} being present, especially in a random-source facility. *Cryptosporidium* seems to be a more common parasite than formerly thought, and research into the public health implications in certain situations is needed.^{6, 49, 61} If coccidian oocysts are found, periodic species identification is strongly recommended. The choice of therapeutic agents and other management procedures obviously depends upon the types of parasites that are present. These may vary with time, season, geography, animal source, and perhaps other factors as well. Frequent surveillance, therefore, is an absolute necessity.

Appropriate virologic examinations should be conducted when signs of enteric disease are noted in several cats in a particular age group within a short period of time, even if parasitism or other causes for enteric disorders are diagnosed. In well-managed cat colonies, enteric disorders should not be a problem in any age group.

Cat breeding facilities must be free from feline leukemia virus (FeLV). If problems such as feline infectious peritonitis, hemobartonellosis, reproductive failure, or unexplained illnesses exist in a cattery, every cat present should be tested for the presence of FeLV. No FeLV-infected cat should be maintained in a colony of breeding cats. Management of FeLV-infected colonies has been reviewed.^{3, 4} A vaccine for feline leukemia virus has recently been introduced.*

Dermatomycosis can be a serious problem in a cattery. In a breeding facility, the problem of effective treatment would likely be greatly magnified. The public health implications are obvious in a facility producing kittens for sale as pets, for example. Therefore, culture of even remotely suspicious skin lesions is recommended.

Because resistant bacterial strains may be a consideration in some instances, appropriately chosen antibiotics and treatment regimens are important. Bacterial infections commonly seen in clinical practice, such as otitis, abscesses, bacterial dermatitis, and so on, should be uncommon in a well-managed cattery. A possible exception might be in facilities with high turnover where considerable veterinary attention may be required for incoming cats. An isolation area is vital in this situation.

Table 4 is a *basic* list of recommended routine "targets" of surveillance. The frequency with which these procedures, and those that are and are not actually necessary in a specific colony, are performed is largely dependent upon whether there is a history of the particular problem, the origin of the cats (that is, SPF, conventional, random source), and the stability of the population over time. A well-managed facility with a stable population may require only minimal surveillance in some areas. The clinical and management personnel in a research facility may wish to consider the eventual gain in the overall quality of health and production in a breeding colony that has been established from SPF or minimal disease stock and

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Table 4. *Routine Screening Procedures for Feline Reproduction Colonies*

ORGANISM	PRACTICAL EVALUATION
Feline leukemia virus	IFA or ELISA
Feline coronaviruses	Serology (interpretive caution required), fecal electron microscopy
Toxoplasma	Serum titer (interpretive caution required), serial fecal flotations
Hemobartonella	Blood smears
Coccidia (several species)	Serial fecal flotations (species identification is desirable)
Helminths	Serial fecal flotations
Ectoparasites	Clinical exams, skin scraping, and/or skin biopsy
Dermatophytes	Culture and identify
Rotavirus (other enteric viruses?)	Fecal electron microscopy
Feline herpesvirus	Clinical signs, virus isolation
Feline calicivirus	Clinical signs, virus isolation
Giardia	Direct fecal smears, ZnSO ₄ centrifugal flotation
Mycoplasma?	Contact experienced laboratory
Chlamydia?	ELISA or IFA with multiple conjunctival scrapings

maintained according to rigid criteria for health and sanitation, even though the initial investment of time and dollars is greater.^{9, 16, 40, 41}

In purebred catteries, the clinician should maintain an awareness that methods of breeding stock selection may exert either positive or negative influences on overall health and that changes in these methods in problem catteries may be vital to their survival. However, because substantive alterations in a breeding program can be economically (and emotionally) difficult to accomplish, the first consideration should be whether the colony surveillance and individual diagnostic procedures have been sufficiently thorough to rule out other possible causes. In addition, possible underlying problems that may be associated with management procedures must be examined.

For example, upper respiratory disease (URD) is one of the most common infectious problems of cats. Feline rhinotracheitis virus (FVR) and calicivirus (FCV) each cause probably 40 to 45 per cent of feline URD, and carrier states exist, with continuous (FCV) or intermittent (FVR) virus shedding.^{2, 17} Complicating bacterial infection is not unusual, and parasitic problems may also be present.^{17, 47} In a problem cattery, antibacterial therapy, along with vaccination program adjustment, may not be entirely satisfactory. Carriers are difficult, expensive, and time-consuming to identify.² A number of other questions must therefore be considered: Are there sufficient air changes? Is some other agent being harbored in the ventilation or water system? Are air filters being changed with sufficient frequency? Is

there overcrowding and too great a degree of close contact, especially within the postweaning age group (decline of maternal antibody)? Is the humidity too low or too high? Are there wide fluctuations in ambient temperature and/or humidity? Are kittens being placed in drafts or in damp areas? Is there excessive traffic, noise, or other environmental stress? Are the cats fighting? Is the drinking water clean? Are employees using adequate personal sanitation, and has instruction on potential fomite problems been provided? Are other species being housed nearby, especially those that may transmit feline viral diseases? Might undiagnosed diseases be present? Is a disinfecting agent causing subclinical irritation to oral and respiratory mucous membranes? Are cleaning chemicals being used precisely according to manufacturers' directions? Is exposure to other irritants possible? If so, from where? What is the level of dust in the building? Is the litter generating excessive dust, or has it been treated with potentially irritating chemicals? Are medications being used inappropriately (that is, indiscriminant use of antibiotics, resistant bacterial strains, steroid-induced recrudescence of FVR²)? Is nutrition adequate? Are waste materials being discarded appropriately and with sufficient frequency? The ability to consider genetics, management, nutrition, and health programs together, rather than as separate entities, is a very important part of the veterinarian's contribution to cattery health.

A necessary part of any health program is thorough consideration of the cause of any mortalities that might occur. This includes both gross necropsy and microscopic pathology, with supportive laboratory diagnostic services, such as virology and bacteriology. The clinician should consult the diagnostic laboratory for proper sample collection, preparation, and shipping procedures. Proper diagnosis and subsequent corrective measures should not suffer because of poor technical procedure or incorrect choice of samples submitted for examination. The clinician should be aware of laboratories specializing in certain types of procedures and must be prepared to provide guidance as to the type of problem suspected (that is, if a virus is suspected, what type of virus; or, if a toxin is being considered, which toxin?). Particularly in breeding facilities, procedural errors can ultimately be financially disastrous and result in considerable discomfort for animals that subsequently become affected if the correct diagnosis is delayed. Failure to aggressively and properly pursue diagnosis under these circumstances has obvious legal implications.

The discovery of increased mortality in any age group carries with it the need for individual diagnosis and the need to integrate that diagnosis (or diagnoses) with observations of overall health and management procedures. This is particularly true and particularly difficult for neonatal and pediatric mortalities. In spite of the many advances in feline medicine and surgery in recent decades, neonatal mortality of kittens continues to be a perplexing and relatively unexplored area.^{41, 54, 56}

It seems reasonable to suggest that the same general causes of neonatal mortality in other species would also apply to the cat. These include infections, genetics, environmental factors, poor nutrition, metabolic dysfunction, and immature thermoregulatory and cardiopulmonary functions.^{19, 20} Patterns of morbidity and mortality can be established if accurate

and complete records are kept. Although this process is time-consuming and expensive, the information can be used effectively, along with other appropriate diagnostic data, in designing effective management changes.

Establishing a specific cause of death in a particular neonatal kitten can be a frustratingly elusive task, even for very experienced clinicians. Recent advances in the study of genetic and metabolic aspects of small animal pediatrics^{33, 34} will enable future progress in the management of cattery health by offering new methods of identifying metabolic abnormalities in at least some, if not many, of the perinatal mortalities that could not previously be diagnosed. New approaches to the selection of animals for breeding purposes may therefore be possible.

Every effort should be made to identify and/or anticipate specific causes of mortality and morbidity, as well as management problems, that may occur in a particular cattery. These problems should be categorized according to the age group of cats affected. Categorization will be very helpful in designing or modifying management programs to eliminate the problem. The clinician should be mindful that changes in one phase of management will affect other colony activities as well. The far-reaching effects of major management changes must be anticipated.

Zoonoses

Working with large populations of animals can mean human exposure to greater concentrations of zoonotic or potentially zoonotic agents and thus, a possible employee health hazard if surveillance, management, and sanitation procedures are not adequate. This is especially true for random-source facilities or facilities in which thorough surveillance and diagnosis have not been practiced. In addition to the more obvious problems presented by diseases such as rabies and toxoplasmosis,³ a number of other agents must be considered today.^{3, 6, 18, 35, 43, 49, 52, 53, 65, 66, 69} Recently, potential public health aspects of FeLV have also been reviewed.³ Employee instruction on personal sanitation and health protection is positively indicated. Because of the nature of the cat, consideration needs to be given to the treatment of bite and scratch wounds, and prophylactic measures (such as rabies immunization) should be established for individuals at high risk of exposure.³

The reasons for and mechanisms of animal health and management systems should be explained to personnel responsible for animal care so that full understanding and cooperation are achieved. Written and frequently reviewed job descriptions and management procedures are mandatory for the medical and legal protection of all concerned.

MANAGEMENT OF REPRODUCTION

It is often assumed that feral cats reproduce more successfully than do cats maintained in breeding colonies. This may or may not be true, and little supportive data are available either way. Healthy, well-managed cats chosen for reproductive service according to practical and scientific criteria, rather than for aesthetic criteria, seldom experience medical or surgical

Table 5. *Evaluating Reproductive Performance: Common Parameters*

Reproductive performance of ancestors, siblings, offspring
Comparative performance on parity basis (requires accurate colony records)
Queen's state of health
Queen's age (prefer less than age 3 at first parity)
Queen's estrual cyclic activity and estrus-mating behavior
Queen's body condition during gestation and lactation (consider with food intake)
Reabsorption, abortion, conception failure
Parturition (time? difficulty? assisted? dystocia?)
Postpartum complications
Cannibalism (queen age, temperament, kitten quality)
Trauma to kittens (over-mothering, queen's temperament)
Birth defects (gross, subgross, metabolic?; genetic, environmental)
Litter size
Birth weights of kittens
Kitten mortality (liveborn, stillborn)
Rate of kitten weight gain through lactation (kitten vigor, quality of lactation)
Temperament of kittens
Temperament of queen (changes?)
Mothering instinct of queen (consider along with kitten quality)
Queen's lactation ability (initiation—first week; maintenance—subsequent weeks); consider along with food intake
Weaning weights of kittens
Postweaning adjustment of kittens (food intake, weight gain, activity, and attitude—accurate reflections of kitten health and maturity)

reproductive emergencies. They may also have a lower rate of subfertility and infertility. Successful gestation, parturition, and lactation in the cat are basically a function of the proper selection of breeding stock, proper nutrition, application of sound breeding management techniques, and a healthy environment.

Records reflecting the quality of reproductive performance should be maintained (Table 5). This type of information is used today in choosing and maintaining breeding animals of many species. Obviously, no queen will perfectly fit any set of selection criteria, and some that score well may not perform well in reproductive service. Performance assessment of toms is possible by the same means. This is especially important in situations in which semen evaluation of breeding toms is impossible. Occasionally, animals may be justifiably chosen for breeding on the basis of something other than reproductive performance.

Prior to breeding, the health and production history of a queen or tom should be assessed.⁶⁰ Only healthy cats, in good body condition, should be bred. Obesity should be corrected prior to breeding, for it adversely affects fertility, parturition, and neonatal survivability. If there is no history of

reproductive service, the production records of closely related cats can be used as a general guideline. The veterinarian should be as familiar as possible with the breeding selection and breeding management systems being employed, so that some anticipation of problems associated with the breeding selection process will be possible.

Male cats may enter the breeding program when they are 12 to 13 months old. Female cats are mature enough to breed at 10 months of age. First parity should occur before 3 years of age. Most queens should not be bred after about 8 years of age.⁶⁰ Many are actually removed from reproductive service earlier, because production tends to decline rather dramatically after about 6 years of age. The breeding life of a tom is at least equally long if illness or poor temperament does not intervene.

In large catteries, breeding is often conducted on a harem (colony) basis, with several cycling queens in a room with each tom.⁶⁰ If this is the case, the performance of each tom must be carefully monitored to avoid the deleterious effects of overuse. In other catteries, two to three toms may be housed with a larger number of queens. In this situation, one tom will generally accomplish the majority of breedings,⁶⁰ and the lack of knowledge of the sire of any individual litter is disadvantageous if a breeding selection program is to be truly effective. Alternatively, individual or caged breeding may be practiced.⁶⁰ This is labor-intensive but does offer the advantage of more precisely timed parturition, known paternity, and known frequency of service for both the queen and tom.

Where possible, queens may be palpated to determine and monitor pregnancy status. With a little experience, diagnosis of pregnancy by day 17 or 18 is not difficult.¹² It is not unusual for queens to deliver fewer kittens than were palpable during the early part of gestation.⁴¹ The reasons for this are not presently understood, but clinicians should avoid predicting litter size based on palpation of queens during early gestation.

Because of the normal behavior patterns of the queens, abortion can be overlooked and colony problems may remain undiagnosed.^{60, 64} Regular palpation of breeding queens should be recommended if this is suspected. It may also be useful to monitor body weight of breeding queens if reproductive failure appears to be occurring (Fig. 1).⁶⁰ It is important to avoid stressing pregnant queens, and manipulation or examination should be done quietly and cautiously in an area where disturbances will be minimal.

Privacy, cleanliness, dryness, and warmth must be maintained in the queening area.⁶⁰ The queening box should allow for additional seclusion. The most commonly used queening boxes are made of cardboard or wood. For ease of cleaning, wood can be painted with a nontoxic paint. Convenience, practicality, cleanliness, and preference dictate the choice.

Queening boxes may be lined with removable, soft carpet pads. Soft, clean cloth or paper is also acceptable bedding if kittens cannot become entangled in it.⁶⁰ Straw, hay, or sawdust for bedding should be avoided. Shredded newspaper works well but has the disadvantage of soiling light-colored hair. Also, a constant source of newspaper, storage space, disposal,

*Wildt, D. Personal communication, 1982.

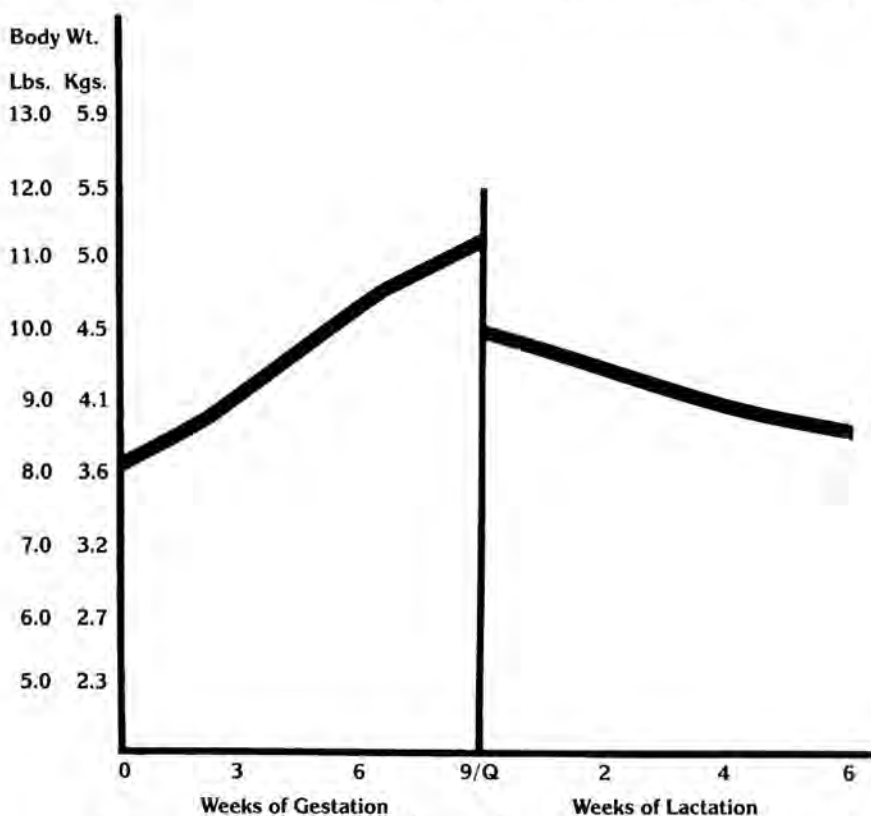


Figure 1. Body weight change of queens during gestation and lactation.

and fire hazard during storage can be additional problems for a large facility. Some queens may prefer to deliver in a litterpan, a less than sanitary event that should be avoided if possible.

The endocrinologic and behavioral aspects of feline reproduction have been reviewed.^{12, 45, 60} In the domestic shorthair and domestic longhair breeds, parturition is usually uneventful if other aspects of management have been correctly handled. This is certainly less true for many other breeds, owing mainly to breeding selection practices that emphasize conformation, for example. The diagnosis and treatment of dystocia should be handled according to published criteria.⁶² In a well-managed cattery, dystocias should be very uncommon.

Partial expulsion of a fetus is probably one of the most common problems experienced by queens during parturition. Assisted delivery via digital manipulation is usually possible, but vaginal lubrication may be required. With any difficult birth, there exists the potential for obstruction of the birth canal. Even experienced cattery operators should be cautioned not to administer ecbolics, but rather to seek veterinary assistance at once.⁶⁰ A thorough history, especially of previous pregnancies, is important. Because of the nature of the cat, inexperienced owners may not recognize dystocia until relatively late in its course. Delivery of normal kittens over

hours to days, without medical or surgical intervention, is not unusual.^{12, 60} In these situations, mortality may be increased in the last kittens to be delivered. When or if intervention is necessary is a matter of individual clinical judgment.

When veterinary examination of queen and kittens becomes necessary, the clinician should carefully note the attitude and activity of the queen and kittens prior to any handling and should then perform a thorough physical examination on the queen and *each of the kittens*. The physical examination of a neonate should begin with observation to determine the relationship of individual kittens to each other and to their dam. Normal kittens will often huddle together, especially during periods of inactivity. Abnormal kittens may be spread about, not seeking one another or their dam. Careful attention should be paid to kittens that are separate from the group. Hungry kittens may be restless and cry but should quiet and sleep when full. Kittens that remain in lateral recumbency for long periods should be monitored carefully.

Physical examination should be performed in the same sequence each time, just as with older cats. The exact sequence itself is probably less important than maintaining consistency. The muscle tone of the kitten should be noted when it is first picked up. The muscle tone of the normal neonatal kitten is not as great as the normal neonatal puppy, and one species should not be used as a standard for the other. Weak kittens may appear to nurse and develop a "full" abdomen. However, they may swallow little milk, filling with air instead. Therefore, if weak but apparently nursing kittens do not improve within the first few hours of life, supplemental feeding should be initiated.

The body temperature of the neonate should also be noted. With a little experience, hypothermia and normothermia can be readily recognized by handling. The normal rectal temperature of kittens at birth has been reported to be as low as 36.0°C (96.8°F), reaching 37.5°C (about 100°F) by age 7 days.⁷ It is important not to warm kittens to adult body temperature. Hypothermic kittens should be re-evaluated frequently to ensure that warming is not too rapid and that normothermia is maintained once it is achieved. Rectal temperature is the most reliable indicator. Gastrointestinal motility and function are not adequate in hypothermic neonates. Warming, therefore, is the first consideration. Parenteral rehydration may be required, but oral feeding should be initiated after warming. Because hypoglycemia often accompanies hypothermia, it may be advisable to initiate feeding with oral dextrose solution that has been warmed to body temperature for affected kittens.

The following outline should aid the identification of some of the more common abnormalities of the neonatal kitten:

Tail—Length, mobility, deformities

Limbs

Deformities or absence of long bones

Number and position of toes and pads

Position of limbs at rest and during movement

Tendon contracture

Soft tissue—Bruises, swelling, wounds
Joints—Deformities, range of mobility

Anus

Patency, redness, swelling, signs of diarrhea
Persistent inflammation may result from diarrhea and/or excessive maternal attention; pain may be present

Perineum—Inflammation, fecal staining

External genitalia

Position and appearance
Inflammation (inappropriate nursing by siblings; excessive queen attention, especially with small litters)
Stimulate urination (urine flow, hematuria)

Spine

Body length as appropriate for size and breed
Deformities (lordosis, kyphosis, scoliosis)

Thoracic cage

Symmetric vs. deformities
If wounds are present (that is, queen trauma) observe respiration and palpate for rib fractures

Ventral abdomen

Pink skin color is normal
Pallor (anemia, which is common in kittens; internal hemorrhage due to birth trauma, torn umbilical vessels, or clotting disorder)
Cyanosis (respiratory or cardiovascular problem; often lungs will have a fetal appearance)
Umbilicus (inflammation, swelling, drainage; normally falls off by 2–3 days of age; occasionally, queen will amputate viscera through congenital or traumatic opening)

Abdomen—Should be enlarged after nursing, with quieting of kitten to restful state. Enlarged abdomen with weakness or continued restlessness may indicate air swallowing or infection and may be accompanied by cyanosis, crying, pain, dehydration, deterioration. Poor prognosis in kittens.

Chest—Auscultation may be attempted but is often unrewarding in neonates unless done serially. Rate and depth of respirations, heart rate, activity level, muscle tone, and nursing ability are useful in serially evaluating kittens. Dyspnea or cyanosis are usually subtle unless the condition is extremely serious.

Skin

Wounds (most often from overzealous queen)
State of hydration (skin wrinkles and loses turgor with dehydration)
Completeness of hair cover, along with birth weight, can indicate state of maturity

Skull

Shape, size

Fontanelle

Head and neck

- Mobility, rooting reflex
- Position at rest and during movement

Ears—Size and position

Eyes and eyelids

- Neonatal ophthalmia
- Eyelids may open as early as 5 days of age; watch for signs of inadequate tear production

Nose

- Appearance and patency of nostrils
- Presence of fluid (mucus, pus, blood, milk, clear discharge)

Mouth

- Color of mucous membranes
- Suckling reflex
- Moistness (hydration)
- Temperature to digital palpation
- Look for litter in mouth if a litterpan is in or near the queening area (interferes with nursing; same may be true for cloth fibers)
- Cleft palate is a common defect (cannot nurse effectively, usually milk exudes from mouth and nostrils, aspiration pneumonia a common cause of death when undetected)

Nervous system

- Responses difficult or impossible to evaluate in weak kittens
- Evaluate alertness and response to stimulus (such as handling), voluntary and involuntary motor function, posture and movement, cranial nerves (some later on). With kittens, serial evaluations are usually necessary to define suspected nervous dysfunctions.

It is paramount to ensure that kittens are nursing effectively. For queens with long hair, dense coats, and/or weak kittens, it may be necessary to clip sufficient hair to allow the kittens easier access to the nipples.⁶⁰ Caution should be exercised to avoid injury to nipples when this is done. The clinician should ensure that the queen has sufficient milk and is nursing and caring for her kittens and that the kittens are able to nurse effectively. For weak kittens, smaller kittens in large litters, and in situations of maternal neglect, inadequate lactation, or lactation failure, the clinician should not hesitate to initiate tube feeding with feline milk replacer* or to cross-foster kittens if this appears necessary. Cross-fostering is preferable if a lactating queen is available, because it is less labor-intensive. Most nursing queens will readily accept fostered kittens, but small or weak kittens should not be placed with larger kittens or with kittens that are more mature, even if their ages are similar. Orphaned kittens should be kept together.⁶⁴

The queen's food intake should be monitored closely during lactation.

*KRM, Borden Laboratories Inc., Elgin, Illinois.

Occasionally, a queen in suboptimal body condition may markedly decrease lactation if food intake does not increase during the first 1 to 4 days postpartum. Therefore, it is advisable to place a highly palatable, complete, and balanced ration within the queen's easy reach.

In the immediate postpartum period, some queens may experience minor temperament changes. Postpartum viciousness should be uncommon with appropriately socialized and managed breeding queens. Queens with poor temperament are better removed from reproductive service.⁶⁰ Queens consistently delivering kittens with low birth weights, genetically mediated birth defects, and high mortality should not be maintained in reproduction. Cannibalism should be an uncommon occurrence⁶⁰ and usually involves queens with nervous temperament or older queens. When cannibalism becomes a colony problem, breeding selection and management procedures should be carefully reviewed.

Most queens spend nearly all of their time in the queening box with the kittens for the first few days after parturition.⁶⁰ This can result in fecal and urine retention by the queens, sometimes to an alarming degree. However, this does not ordinarily result in complications. This situation is managed by placing a fresh litterpan in the cage and removing the kittens for 30 to 60 minute periods, as needed. On rare occasions, enemas or oral lubricants may be required but should be used very judiciously and with close veterinary supervision.

Normal kittens should be weighed about once a week. If birth weight is low or if signs of illness are seen, they should be weighed every 48 to 72 hours. Where more extensive intervention is needed, such as orphan-rearing, daily weight measurement is most helpful. Normal birth weight for kittens is considered to be 100 ± 10 gm.^{7, 60} The very minimum acceptable weight gain for nursing kittens is about 7 to 10 gm per day.⁷ Kittens that succumb during the lactation period or immediate post-weaning period are often those that had low birth weights and/or poor growth during early to mid lactation. These occurrences can frequently be anticipated by closely monitoring birth weight and growth during lactation. The basic causes of, and solutions for, these problems are probably multiple and are presently poorly understood. Therefore, therapy will be basically supportive in nature.

Often, decreased muscle tone and activity precede the onset of other outward signs of illness in neonatal kittens. The clinician should closely monitor the progress of such kittens, as they very rapidly lose the ability to nurse effectively and may be neglected by the queen. An effort should be made to provide poorly nursing kittens with colostrum if at all possible.

Other than monitoring the progress of queen and kittens and observing the general feeding guidelines discussed in the next section, there is probably little reason to intervene during a normal lactation. Frequent, gentle handling of young kittens does seem to improve both physical and social development.⁶⁴ Kitten mortality should be very low from about day 4 of life through weaning.⁴¹ Health problems in queens during the lactation period are rare. When prescribing medication for lactating queens, it is necessary for the clinician to ascertain whether the drug or its metabolites will be excreted in the milk and how this might affect the kittens.

Depending upon the queen's body condition and the progress of the kittens, weaning of the kittens may take place between about 6 and 8 weeks of age.⁶⁰ Most healthy kittens that weigh over 500 gm at age 6 weeks can be weaned at this time. Smaller kittens may be too immature and may benefit from additional time with the queens, provided her physical condition permits. Some queens will cycle again prior to weaning, and prevention of mating is desirable. After weaning, the queen should be placed in a low-stress environment for a period of readjustment.

LIFE STAGES AND FEEDING: THE QUEEN AND TOM

The nutrient requirements of reproducing queens and young growing kittens are as much as two to four times greater than those of the inactive adult cat. In addition, special feeding habits are important to the delivery of those nutrients. Providing proper nutrition to the reproducing queen directly influences kitten survivability by affecting the physiologic maturity and birth weight of the kitten(s) and the queen's milk production.

Good-quality complete and balanced commercially available diets that contain more than 1700 digestible calories per lb of food and at least 30 per cent of highly digestible protein (dry cat foods of approximately 10 per cent moisture) should provide adequate nutrient density to support feline reproduction. Diets labeled for adult maintenance, intermittent feeding, or therapeutic uses are generally inadequate for gestation and lactation. Any diet fed should be labeled as nutritionally complete and balanced for the appropriate life stage of the cat and should have these claims supported by actual feeding studies.

With proper care, the breeding queen will already be in good body condition that is appropriate for the particular season of the year and should be on a ration of high nutrient density prior to breeding. The hormonal and behavioral changes that occur during reproduction cause periods of undereating, overeating, and even cessation of eating—the "reproduction roller coaster." Feeding a palatable ration, with high nutrient density, and maintaining an appropriate body condition can minimize the "thrills" of this roller coaster. Transient refusal of a palatable, complete, and balanced ration can simply represent a natural behavioral change. Cycling queens commonly have poor appetites during part or all of estrus. This short-term loss of appetite alone is not cause for concern and does not affect fertility or litter size in normal queens. However, if a maintenance ration is being fed at this time, a change should be made to a ration that is more appropriate for reproduction.

Once bred, a queen should continue to consume a normal prebreeding quantity of food during early pregnancy. At about 3 weeks of gestation, most queens undergo another short period of partial appetite loss that typically lasts 3 to 10 days. A slight, transient weight loss may occur along with the decreased appetite in some queens. In others, the rate of the slight, early weight gain simply declines temporarily.

Therefore, just 3 weeks into pregnancy, two normal episodes of appetite loss and possibly a period of transient weight loss have been experienced

Table 6. *Queen Feeding*

LIFE STAGE	AVERAGE WEIGHT (LB)	FOOD SOURCE	CALORIES/LB BODY WEIGHT/DAY*
1 yr +	7.7 ±	Cat ration	50
Gestation	7.7-10.7	Cat/kitten ration	50-75
Parturition	10.7-9.7	Cat/kitten ration	75
Lactation	9.7-7.7	Cat/kitten ration	75-100
Weaning	7.7 ±	Cat ration	50
Maintenance	7.7 ±	Cat ration	50

*Indicates approximate caloric needs during periods of normal consumption for the appropriate life stage.

Transient normal periods of behavioral inappetence or management via feed restriction (that is, at weaning) may be expected as contrasted with anorexia for other reasons.

by a normal pregnant queen. A certain amount of owner anxiety is to be expected and it is important to resist making changes in the diet or feeding program every time the queen reaches a "dip" in the roller coaster. These events are perfectly consistent with (although not necessary for) normal and even exceptional reproductive performance. Feeding a high-quality complete and balanced ration is more appropriate to normal gestation than several changes in diet, or the addition of supplements, which may only serve to unbalance a proper ration.

The fecal quality of a normal queen may range from soft (diarrhea is not normal) to very firm (constipation is not normal) during reproduction. Feeding a ration that a cat has previously handled well offers some assurance that transient changes in fecal quality probably represent physiologic changes and not ration problems. Rations that result in very firm, low-volume stools when fed during nonstressful situations may not be advisable during reproduction because of the risk of constipation and perhaps tenesmus. Rations with increased nutrient density are also preferred because the increased nutrient requirements of reproduction may be met without excessive food consumption, thus avoiding the likelihood of gastrointestinal upsets.

During weeks four through six of gestation, the queen should show a slow, steady increase in body weight (see Fig. 1). Body condition should be maintained as appropriate for the season of the year. Food consumption should be allowed to increase slightly during this time (Table 6). Queens that are underweight during mid and late gestation may have difficulty maintaining body condition and milk production after parturition. On the other hand, obesity will reduce reproductive performance and represents a health hazard to the queen and the kittens, as dystocia and increased kitten mortality are both much more common in obese queens.⁴¹ The alert clinician or cattery operator may be able to anticipate problems at or after parturition by careful monitoring of the queen's body condition and food consumption during gestation.

During the final 3 weeks of gestation, body weight will increase more rapidly (see Fig. 1). Growing kitten fetuses, developing placental tissues,

Table 7. *Kitten Feeding*

AGE	AVERAGE WEIGHT (LB)	FOOD SOURCE	CALORIES/LB BODY WEIGHT/DAY
0-3 days	.20	Colostrum	—
3-21 days	.20-.80	Queen's milk	—
21-42 days	.80-1.4	Queen's milk Queen's ration, moistened	—
6 wk-6 mo	1.4-6.0	Kitten ration	100-75
6 mo-1 yr	6.0-7.7	Kitten ration	75-50
1 yr +	7.7 ±	Cat ration	50

fluid, and developing mammary glands contribute to the queen's increasing body weight and nutrient requirements in late gestation. Food consumption should increase more rapidly during this time, and some fleshiness beyond what might be seasonally appropriate is allowable. Free-choice feeding or multiple daily feedings are appropriate. As fetal size increases, less abdominal space is available for the digestive tract. The consumption of smaller meals at increasing frequency is one means of compensation. Queens carrying large litters may become uncomfortable during the last trimester, leading to reluctance to exercise, decreased food intake, and, potentially, difficulty during parturition. Selecting for breeding queens that routinely deliver very large litters may therefore be inadvisable.^{41, 60}

As littering nears, the queen may again lose her appetite. In many queens, food refusal during the ninth week of gestation is a good indication that littering will occur within the next 24 to 48 hours. Usually within 24 hours postpartum, the queen's appetite will return and her food consumption will have increased over prepartum amounts. Food and water consumption should be encouraged so that body condition and lactation are maintained (see Table 6). This can be accomplished by moistening a food with high nutrient density with water before serving. The addition of water increases the palatability of the ration and increases water intake, which is important for milk production. Queens with large litters or those queens that are very attentive mothers and rarely leave the kittens to feed themselves will need more encouragement to eat and drink. On the other hand, queens with small litters may need to have food restricted. Inadequate milk production can limit kitten development, whereas excessive milk production can lead to mammary congestion and discomfort.

The demand for milk by nursing kittens will continue to increase for about 20 to 30 days. Hence, the queen's food and water requirements increase during this time. During peak lactation, the queen's food intake may be two to four times maintenance levels, whereas at the end of gestation, intake levels are usually less than 50 per cent above maintenance. Because the kittens' interest in solid food increases at about weeks 3 to 4 of lactation,⁶⁰ and because the queen's interest in nursing begins to decline at about the same time, the demand for milk, and hence, the queen's food intake, should be gradually reduced (Tables 6 and 7). By weaning, the

queen's food consumption should again be near maintenance levels. If body weight of the queen declines excessively during lactation (Fig. 1), reconditioning following weaning should be closely monitored. Mating should be prevented for these queens until body condition is again acceptable. Reproductive and other health parameters should be carefully reviewed for queens that repeatedly lose excessive body condition during lactation.

For queens that maintain significant milk production immediately after removal of the kittens, mammary congestion and discomfort can be a problem. Resolution of this problem may be hastened by limited feeding ($\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ of normal maintenance food levels for successive post-weaning days), if the body condition of the queen permits. Also, starting the kittens on solid food at 3 to 4 weeks of age will have reduced milk demand by weaning time.

Cool, fresh water that is changed at least once a day should be available to queens and toms at all times. During pregnancy, water serves as a carrier of nutrients to, and of wastes eliminated from, developing fetuses. Adequate water consumption is necessary for normal thermoregulation and milk production. Frequent changing of the water and cleaning of the water bowl tend to encourage water consumption.

Male cats used infrequently as sires do not require special feeding. However, because some breeding toms in heavy service or with extended exposure to cycling queens may reduce food consumption and lose weight, care should be taken to maintain good body condition. They should be fed a ration high in nutrient density. Actively breeding toms may not groom themselves effectively, and attention should be given to skin or hair-coat problems that may result.

LIFE STAGES AND FEEDING: KITTENS

The feeding of a kitten begins at the time of conception. Fortunately, the queen assumes responsibility for providing nutrition to her kittens throughout the 9 weeks of gestation and through most of the 6 weeks of lactation. Nutritionally, the first 36 hours may be the most significant period of a kitten's entire life. Some caution is advisable at this time with inexperienced queens. Kittens should be encouraged to nurse often. This may involve working with the queen and/or her kittens (if the queen permits), placing them near nipples at feeding time, and encouraging a nervous queen to lay quietly as her kittens nurse. Routinely handling the queen and kittens allows an opportunity to monitor the progress of the litter and aids in kitten development.⁶⁴

During the first 24 to 72 hours of lactation, the queen produces colostrum. Nutritionally, colostrum differs from milk. After approximately 24 to 72 hours, lactation gradually changes from colostrum to milk (see Table 7). The content of various nutrients in queens' milk changes as lactation progresses. Queens' colostrum contains about 88 per cent water; milk contains about 82 per cent.³⁶ The protein content of colostrum gradually increases from 4 per cent at 0 to 2 days of lactation to 6.6 per cent in milk at weaning.³⁶ Similarly, the fat content gradually increases from 3.4 per

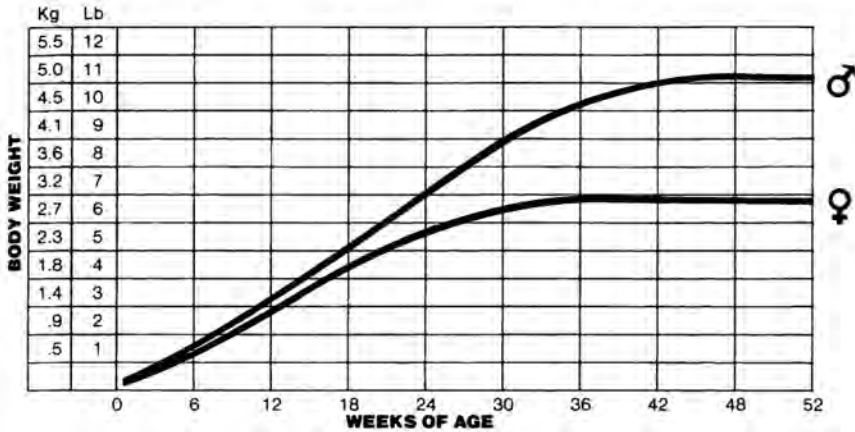


Figure 2. Feline growth curve.

cent at 0 to 2 days of lactation to 5.5 per cent at weaning.³⁶ The mineral composition also varies with lactation, presumably delivering specific nutrients at the appropriate levels, at the appropriate time.³⁶ In the first days of life, the newborn kitten is able to absorb such whole dietary proteins as immunoglobulins, which are provided in colostrum.

Kittens should be introduced to solid food around 3 to 4 weeks of age.⁶⁰ Typically, the kittens romp around, trip over the lip of the queen's food bowl, and fall muzzle first into the ration. This alarms some novice cat owners, but normal eating behavior is soon learned. Canned, soft-moist, and dry rations moistened with water can all be nutritionally complete and balanced for young kittens. However, the physical form (that is, size, shape, texture, moisture) and nutrient density of the diet are important for palatability. The diet should, of course, be labeled as complete and balanced for all life stages of cats. Kitten activity will tend to compact most rations, thus decreasing their appeal. Restirring these compacted rations at frequent intervals or offering fresh food periodically in bowls that are easily accessible to kittens is advised.

Young kittens are sometimes fed a mixture of milk, baby cereal, vitamins, eggs, meat, or other similar ingredients as a "weaning formula." This type of diet is both expensive and time consuming to prepare. Most importantly, it may not be nutritionally complete and balanced. Preparations of this type should be avoided unless the nutritional composition is known.

Consumption of solid food must proceed normally if the kitten is to withstand the stress of weaning. The clinician should be certain that 4- to 5-week-old kittens are in fact taking solid food. Lack of appropriate solid food consumption is often reflected in a decreased rate of weight gain for kittens after the fourth week of lactation, when the queen's milk production may decline and she becomes more reluctant to nurse (Fig. 2).

By 6 weeks of age, weaning should be complete. Some breeders feed kitten rations to both reproducing queens and kittens or continue to feed nutrient-dense reproduction rations to weaned kittens. Both feeding strategies are designed to eliminate the stress of a postweaning diet change on kittens. Again, the critical issue is that the diet fed should be nutritionally complete and balanced for the intended purpose. When a complete and balanced diet is fed to normal healthy cats of any breed, no additional supplementation in the form of vitamins, minerals, meat, or other additives is needed. A common problem is that calcium, and possibly other vitamins and minerals, are often added to the diets of pregnant and lactating queens and growing kittens. Although it is true that more minerals are needed at these times, these minerals are obtained through increased consumption of a good-quality complete and balanced diet.

Proper diet selection and feeding techniques affect kitten survivability and growth and thus can have an important economic impact on a cattery. The clinician should be alert to the feeding habits that cattery owners promotes, as this is an integral part of a successful overall management program.

SUMMARY

Sound, active programs for management and disease control are crucial to the long-term viability of a feline reproduction colony. The guidelines provided here may be individually tailored for management programs in catteries of all sizes. The clinician involved with the health care of reproducing cats incurs a broad range of responsibility, and the impact of incomplete application of basic principles must be appreciated.

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