Sample

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JOURNAL of Wildlife Rehabilitation

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Rehabilitating Fox Squirrels . . . . . p. 5

Guidelines for Authors

The *Journal of Wildlife Rehabilitation* is designed to provide useful information to wildlife rehabilitators and others involved in the care and treatment of native wild species with the purpose of returning them to the wild. All feature articles are subject to a review process, and our staff and reviewers work with authors to produce the most accurate information possible in our ever-changing field.

The *Journal of Wildlife Rehabilitation* has various feature categories. We solicit submissions in the form of feature articles, rehabilitation notes, book reviews, news articles related to major events in the field, and selected case studies. Articles on veterinary medicine as it relates to wildlife rehabilitation are also welcome. We would like to expand the *Journal of Wildlife Rehabilitation* to include wildlife rehabilitation articles from countries outside the United States and welcome inquiries regarding such articles. We also have two short features we use for basic information: "For The New Rehabber" and "Simple Things That Make a Difference." They are intended for basic information or new ideas that are easily demonstrated with a short text and photos. All authors receive a $25 honorarium for each article accepted for publication or provide a one year membership or renewal.

Submission Instructions

1. An original and two copies of the manuscript should be submitted to the Editor, IWRC, 4437 Central Place, Suite B-4, Suisun, California 94585, USA. The manuscript should include references, photo legends, and footnotes, and should be typewritten, double-spaced, if possible. The author's name, address, and phone number should be placed on at least the first page of the article so it can be readily identified and the author contacted. Please note that each article should be accompanied by an abstract. If tradenames are used for products mentioned the author must indicate whether the product is ™ or ®. A product table at the end of the article should give readers the name and address of the companies involved and generic name or category of product.

2. The *Journal of Wildlife Rehabilitation* is prepared on a Macintosh personal computer with desktop publishing software. If papers are already on a personal computer disc, the submission cover letter should include that information, as well as what type of hardware and software systems were used. Obviously, being able to use the author's disc directly or translate it by machine to Macintosh format prevents input errors and speeds up the process. We are able to translate many IBM files provided that the software (including version) are written on the disk.

3. Manuscripts are received with the understanding that they have not been accepted for publication elsewhere. **It is the author's obligation to obtain permission or reprint rights if the submitted copy has been published elsewhere.** All accepted manuscripts are subject to editing. Unused manuscripts will be returned.

4. A separate page should be submitted with a short synopsis of information on the background of the author. Included should be the name, address, rehabilitation organization, phone number of the author and a biographical paragraph. Where appropriate, please list any academic degrees, special training, or experience that is relevant to the article (i.e., physical therapy—RPT, etc.) Articles pertaining to areas of veterinary medicine that involve tasks or decisions requiring a licensed veterinarian (e.g., soft tissue or orthopedic surgery) require a veterinarian as either the author or a co-author.

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6. Acknowledgments are limited to people who have contributed to the article in a major way.

7. References should be noted in the text with the last name of the author and the year published (i.e., Leighton, 1983) and listed at the end of the manuscript in alphabetical order in the following style:

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Features

Feeding Fawns: A Strategy for Wild Returns
Cheryl Millham
Lake Tahoe Wildlife Care Center
South Lake Tahoe, California

Jan White, DVM
Suisun, California. 3

Rehabilitation Notes: Tree Squirrels
Kerrin Grant
Laurel Creek Wildlife Center
Hillsboro, Oregon 5

Intraosseous Fluid Administration Utilizing the Avian Femur
Janna Wynne, DVM
Studio City Animal Hospital
Studio City, Calfornia 21

Departments

Editorial 2

Book Review. 24
"Health & Management of Free-ranging Mammals"

Cover Drawing: Kerrin Grant

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Editorial . . .

In Pursuit of Excellence

We talk a lot about professionalism in wildlife rehabilitation. IWRC wants to help you more than talk. We believe that professionalism should be the cornerstone of wildlife rehabilitation. It is the central theme of all of our committees. First, we created the journal and a national annual conference, then we designed standardized educational classes for wildlife rehabilitation, and then the joint standards and accreditation program. So now what?

We are looking at wildlife rehabilitation as more than just doing a job, a hobby or performing average work. We want to foster excellence—working at peak capabilities to achieve a standard that is well above ordinary. How does a professional organization like IWRC assist you to do that? Well, we are working towards this goal in a number of our programs. Working with the American Veterinary Medical Association (AVMA), we have submitted the curricula for both our basic and advanced Skills Seminars ℠, as well as our annual conference, for review and assignment of continuing education hours (CE). The 16th annual IWRC conference has been approved for up to 22 CE hours. These hours are required by many states for the renewal of veterinary licenses. Some states are also requiring wildlife rehabilitators to complete a given number of CE hours to renew their licenses. Toward that end, IWRC will likewise assign CE hours to the Skills Seminars℠ and conferences for wildlife rehabilitators. State organizations may also request IWRC to review their regional conferences for assignment of CE hours. For more information regarding this service, contact our office.

For our participants, CE hours will be noted either by certification or in letter form. As is traditional at medical conferences, certificates are given at registration. For skills seminars, certificates are issued following the completion of required work.

And that's not all. We are continuing to work on making the Standards and Accreditation Program℠ available across the country. This is no small feat and will require grants or corporate support. We will keep you posted. In addition, the joint standards committee has begun to lay the foundation for a Standards of Excellence program. This program is designed to recognize those wildlife rehabilitators or organizations who have achieved a standard of excellence and are taking a leadership role in current practices in the field. This level of the program is designed for those who have already met the basic standards program.

And there's more! We continue to upgrade the *Journal of Wildlife Rehabilitation*. We are now being indexed and abstracted by *Focus On: Veterinary Science and Medicine*™, SCISEARCH®, RESEARCH ALERT® and the Wildlife Disease Review. These publications make our information more accessible on a worldwide basis to a wide variety of health professionals. Our next project for the Volume 17 series is to begin offering continuing education questions and credit for journal articles. The details are daunting and while we make no guarantees on when we can implement this project, you can be assured that IWRC is constantly trying to professionalize wildlife rehabilitation in our pursuit of excellence on your behalf.

-Jan White, DVM-

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Feeding Fawns: A Strategy for Wild Returns

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ABSTRACT

Proper rehabilitation of big game animals is a large responsibility for wildlife rehabilitators because these animals can present a life-threatening danger if they are unafraid of humans. This article describes a remote feeding device (lamb bucket) that assists the rehabilitator in keeping fawns from becoming tame or accustomed to humans at feeding time.

KEY WORDS: deer, fawns, lamb bucket, remote-feeding devices, and deer rehabilitation

Introduction

Raising fawns wild for release back into their native habitat must be done well or should not be done at all. Deer have sharp hoove edges and the males grow antlers, both of which constitute lethal weapons if used to attack a human. While such injuries are uncommon, in the early 1970's a unlicensed deer keeper was gored to death by a yearling in Napa county California. Big game animals must display a healthy fear of humans and avoid them. Failing to do so will often result in their death and/or injury to the people that encounter them.

Nursing fawns have been traditionally hand-fed using a bottle or bottle-fed using a rack. Hand-feeding creates a situation where the fawn associates feeding with the caretaker so wildlife rehabilitators train them to use remote-feeding devices to reduce the human-animal bond. Fawns are grouped, fed and reared as a herd. This is only one part of an overall rehabilitation program that when successful will result in wild fawns that survive in the wild.

Lamb Buckets as a Feeding Mechanism

Feeding fawns using a rack has been previously described and is commonly known to be an effective rearing tool (Forness, 1984, Martin-Dolmans, 1992). Sometimes, a more portable system can be useful, especially if fawns are successively moved from smaller quarters to larger housing.



Lamb bucket feeding system used at the South Lake Tahoe Wildlife Care Center.

At Lake Tahoe Wildlife Care center a "Lamb Bucket" system (Nasco West) was used during the 1993 fawn season for 16 fawns. The bucket has 10 black lamb nipples and tubing. A brace for the bucket is sold seperately to anchor the bucket. In this case, the brace attached the bucket to a tree stump.

This system is best used for fawns once they are known to be adequately self-feeding because individual consumption cannot be monitored.

Advantages

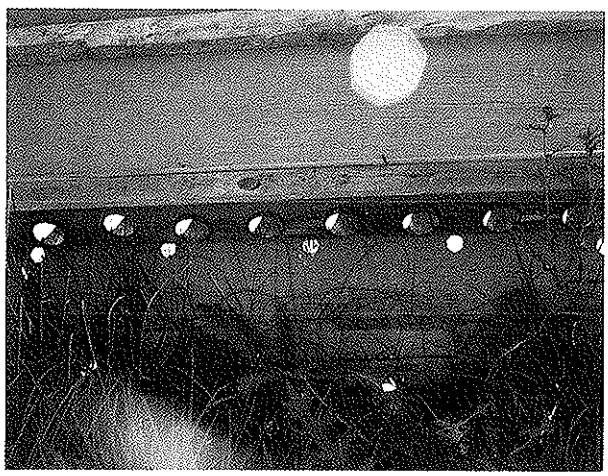
Due to the remote-source nature of the apparatus, fawns identify the bucket as their source of food—not the rehabilitator. Feeding together, they "compete" with their conspecifics for the formula and the access nipples. This helps to stimulate formula intake.

Once the formula is placed in the bucket, the fawns are allowed into the feeding area and begin feeding. The rehabilitator can take the opportunity, when necessary, to check their annus to be sure than none of the fawns have scours and then leave the area.

Once the fawns are done nursing and have left the area (about two hours), the bucket can then be retrieved and cleaned.

Disadvantages

It is not possible to monitor how much each fawn is eating, so a fawn who begins to fail may be missed. Reduced human contact increases fawn reliance on each other but in a group, it is easy to miss early signs that an individual is not doing well.



Traditional remote-feeding fawn rack used at Wolf Hollow Wildlife Centre, San Juan Is. WA.

Due to the feeding system, some formula will be wasted. However, always have a little more formula in the bucket than it is estimated to be needed. If not, fawns will suck air and not be satisfied.

These buckets feed 10 fawns at a time. To feed more, additional nipples and hoses can be installed or more buckets can be utilized.

Conclusion

Remote-feeding devices can help raise fawns and keep them wild. Individuals should be evaluated and known to be adequately self-feeding prior to group feeding. Because of the inherent dangers of rearing big game mammals, wildlife rehabilitators should use all methods available to ensure that deer are raised wild and are not accustomed to people. The lamb bucket method can be a valuable adjunct to a comprehensive rehabilitation program for deer.

References

Forness, Mary C. 1984. "Raising White-tailed Fawns 'Wild.'" *Wildlife Journal* 7(4): 5-6, 11-12.

Martin-Dolmans, Kimberly. 1992. "Raising White-tailed Deer in Washington: A Successful Fawn Strategy." *Wildlife Journal* 15(1): 3-8.

Product List:

Lamb Bucket: Nasco West, P.O. Box 3837, Modesto, California 95352-3838 Cost: $60.00

Author Profiles

Cheryl Millham *has been a wildlife rehabilitator since 1978. She is the executive director and co-founder of Lake Tahoe Wildlife Care, a general wildlife center than cares for 1,000 animals annually. Cheryl is a licensed vocational nurse who brings her human skills to wildlife rehabilitation. Lake Tahoe Wildlife Care is an IWRC Accredited facility.*

Jan White, DVM *, has been a wildlife rehabilitator since 1975. In that time she has served as the founder and director of the Suisun Marsh Natural History Association, and the operations manager and staff veterinarian for the International Bird Rescue Research Center in Berkeley, CA. Presently, she is the executive director of the IWRC, and a staff research associate at the School of Veterinary Medicine, Davis, CA where she teaches and assists in the development of the Wildlife Health Center.*

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Rehabilitation Notes: Tree Squirrels

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ABSTRACT

North American squirrels fall into one of four categories, based on physical characteristics, social structure, diet and habitat. "Tree Squirrels" include species within the genera, *Sciurus* and *Tamiasciurus*.

Infant tree squirrels are fed a diet based on Esbilac™ or Vetalac™ formulas which should be modified with heavy whipping cream to closely match the natural mother's milk.

Housing needs for tree squirrels change from birth to release (approximately fifteen weeks of age). Small aquariums are suitable for young infant; cages 6'L x 4'W x 6'H are required for prerelease juveniles and adults.

An amino acid solution was tested as a rehydrating formula and diluent for infant formulas during the transitional period from intake to the point when the infant can properly digest the concentrated formula. The Amino Acid Solution™ contains 11 essential amino acids, electrolytes and B vitamins. Though caloric content is minimal, it contains more than three times the calories as Pedialyte™.

Squirrels can suffer from several health problems and injuries such as mange, abscesses and head/ spinal injuries. They can also suffer from central nervous system disorders resulting from raccoon roundworm infections. Treatment for these conditions is presented.

KEY WORDS: Squirrels, Tree; *Sciurus spp.*, *Tamiasciurus spp.*; chickarees; rehabilitation, captive husbandry; diet/ formulas

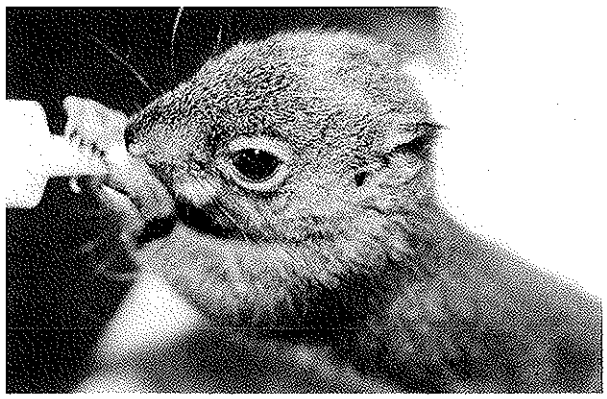
INTRODUCTION

North American squirrels fall into four main categories based on physical characteristics, diet, food-caching strategies, habitat and social structures. "Tree squirrels" is one category and includes species from two genera. The genus *Sciurus* includes the larger tree squirrels such as Eastern Gray, Western Gray, Fox, Abert's Squirrel and Arizona Gray Squirrel. The second genus, *Tamiasciurus*, includes two species of small tree squirrels commonly called "chickarees." Specifically, they are the Douglas Squirrel, seen west of the Rockies, and the Red Squirrel, found on the east side.

The other three categories of squirrels are: 1) flying squirrels, 2) ground squirrels and 3) chipmunks. Because of differences in physical characteristics, diet and social structures, they will not be included in this article, with the exception of a few specific comparative comments regarding their care in rehab centers.

NATURAL HISTORY

In Latin, *Sciurus* means "shade tail" and refers to the bushy tail seen in all species of "tree squirrels." The tail is used for thermoregulation, balance and communication. They live in predominantly forest habitat and consume an herbivorous diet. Seeds (including nuts), fruit, buds, leaves, bark and fungi comprise the main portion of their diet. Tree squirrels may also eat invertebrates, especially earthworms and beetles. There have been reports of tree squirrels consuming birds' eggs and nestlings, however, this phenomenon mainly occurs with the more omnivorous flying squirrels. Soil may also be consumed to obtain needed minerals in the diet (Gurnell, 1987).



Fox, Eastern Gray, Western Gray and Arizona Gray Squirrels live mainly in deciduous or mixed forests. They nest in trees although they may also have ground nests or burrows. Fox and Eastern Grays can also inhabit areas near humans and are commonly seen in city parks. The Western Gray is more shy than its cousins and does not adapt well to areas of human habitation. The *Tamiasciurus* species (Douglas and Red) live in coniferous forests. They may also be seen in mixed forests that are predominantly coniferous.

One common difference between the *Sciurus* and *Tamiasciurus* genera is their size. The *Sciurus* squirrels are commonly referred to as "large tree squirrels." With the exception of the Western Gray, all healthy adult *Sciurus* squirrels weigh at least 400g (slightly less than one pound). The Eastern Gray weighs 410-710g, the Fox Squirrel 504-1062g (Whitaker, 1980). Western Grays may weigh between 340-964g. The large variation takes in account regional differences across the country. *Tamiasciurus* squirrels, commonly called "chickarees" weigh, as adults, in the range of 140-300g (5-10 1/2 oz.)(Whitaker, 1980).

Another main difference between the two genera involves their seed-caching strategies. Both groups store fungi and will wedge them into the crooks of trees so they can dry out for the winter. However, the types of seeds they store and the techniques they use are quite different.

Sciurus squirrels use a technique called "scatterhoarding" (Gurnell, 1987). The squirrels use this technique to cache a few seeds in many different spots of a given area. The squirrels do not strongly defend these caches. Instead, they bury the food in a shallow pit and cover it for future use. Then they move on, collecting food in other areas. When they need supplemental food, they will smell where buried food is located. The small cache that it digs up may have been buried by another squirrel. In the case of Fox Squirrels, favored feeding stations may be defended, but large territories are not.

One theory for the scatterhoarding technique explains it as a way to reduce competition with other seed-eating animals, especially birds. If the seeds were buried in one large pile, birds would come in and devour the entire stash, leaving the squirrel with no supplemental food for the winter. It follows the old adage, "Don't put all of your eggs in one basket."

Tamiasciurus squirrels use a different technique for seed-storage called "larderhoarding" (Gurnell, 1987). In Latin "tamias" means "storer" which aptly describes these squirrels. In late summer and fall they will snip off cones from a tree and let them fall to the ground. They collect these cones later and carry them off to a central storage area called a "midden" (Gurnell, 1987). Middens are built up over a period of years by a single squirrel. The middens are located within a strongly defined and strongly defended territory. The design of these storage areas provides a moist, cold area that preserves the seeds for years. The squirrels depend on these food stores during the winter months when food is scarce.The middens can also provide supplemental food during other parts of the year if fresh vegetation is scarce.

The accepted theory behind larderhoarding explains it as a means of energy conservation on the part of the squirrel. Squirrels expend less energy if they have food stashed in one area instead of foraging over a larger area. The smaller squirrels typically have a faster metabolism than the larger species so they expend more energy while engaging in the same activities. The larderhoarding strategy compensates for that. In addition, the types of seeds that are cached by chickarees are from coniferous tree cones. Apparently the seeds within the cones will "keep" for extended periods of time, much longer than seeds found in deciduous forests (Gurnell, 1987).

In regards to food preference, Red Squirrels prefer hazel nuts over other seeds. Their second preference is beech nuts, then spruce cones, and lastly pine cones. Douglas Squirrels prefer cones from Pacific Silver Fir, then Douglas Fir, spruce, and lastly Western Hemlock (Gurnell, 1987).

Fox Squirrels prefer White Oak acorns over the Black Oak group because they contain less tannin. Tannin is a chemical found in some plants that binds with proteins and gives an unpleasant taste (Gurnell, 1987). Abert's Squirrels feed on the inner bark of the Ponderosa Pine twigs during the winter.

The natural predators of squirrels include, but are not limited to the following: Canids (dog family), felids (cat family), raccoons, hawks and owls. Domestic cats, dogs and humans also prey on various members of the squirrel family.

INFANT CARE

The gestation period of tree squirrels is 31-45 days, depending on the species. Litters of two to seven kits are born in March and April. Fox Squirrels commonly have a second litter in late summer.

The care of infant squirrels can be broken down on a week by week basis from the point of intake to release.

Table 1: Energy Content of Natural Squirrel Food, Measured in KiloJoules /gram Dry Weight.*

FOOD	ENERGY CONTENT	FOOD	ENERGY CONTENT
White Oak acorns	18.8	Norway Spruce	25.1
White Oak buds	19.3	Ponderosa Pine	31.8
White Oak flower	19.3	Lodgepole Pine	28.5
Black Oak acorn	22.6	Western Hemlock	28.5
Hazel nut/Filbert	32.9	Douglas Fir	29.7
Beech nut	29.1	Subalpine Fir	29.7
Elm	23.2	European Larch	27.1
Elm buds	18.8	Hickory buds	20.1
Elm flower	18.0	Hickory flower	18.4
Black Walnut	29.3	Blueberries	22.2
Scotch Pine cones	27.0	Fungi (average of 8 spp.)	17.6

*From *Natural History of Squirrels* by J. Gurnell, 1987.
Seeds are more digestible than green plant material that contains cellulose. The digestibility of seeds is 88-96%. The digestibility of stems and leaves is 60-70%.

Birth to Two Weeks

Squirrels are hairless at birth and cannot thermoregulate for even a few minutes. They must be kept on heat continuously. They can be housed in a 5 gallon aquarium or equivalently-sized cardboard box that can be kept on a heating pad set on LOW. Pillow cases or good quality face towels (no holes) can be used to line the bottom of the tank or box. Feed approximately every 11/2 to 2 hours, even through the night. A latex gavage tube can be attached to the end of a 1 ml tuberculin syringe to feed tiny infants. (See Figure 1). Stimulate infants to urinate and defecate by gently rubbing the perineum with a warm, moist towel. At this point the stool will be mustard-colored and of toothpaste consistency. Weigh squirrels daily and modify food intake as their weight increases. The mathematical formula below should be used to calculate the amount of Kilocalories each animal needs to consume every 24 hours to ensure proper growth rates.

$$70 \times (\text{body weight in Kg})^{.75} \times 4 = \text{Kcal/24 hours}$$

By two weeks of age the period of time between feedings can be increased to every 2 hours with a 4 hour break during the night.

Two to Three Weeks of Age

Hair should be dark fuzz at two weeks and completely in by three weeks of age. Ear canals open around three weeks (Gurnell, 1987). By three weeks the gavage tube can be removed from the syringe although smaller species may require the gavage tube for this long. Stimulation is still required after feeding. Watch for diarrhea not associated with feeding technique or formula. While the prepatent period for coccidia varies from coccidia to coccidia (i.e., 5-12 days) it is unlikely to cause illness within the first week of life. *Eimeria ontarioensis*, a known coccidia of Fox Squirrels has prepatent period of 7 days and a patent period of 21 days (Joseph, 1973).

Three to Four Weeks

Generally the eyes start to open but don't focus completely until the end of the fourth or early in the fifth week. Social bonds occur during this time so kits should be kept in pairs or groups, if possible. Kits should be urinating/defecating without stimulation by the time the eyes open.

Four to Five Weeks

Eyes will be open and focusing. Feeding instruments can either be a syringe (size based on the amount consumed at each feeding) or pet nurser. Kits will be very active during this time. Kits should be moved to a larger enclosure to allow for climbing and play activity. A 15 gallon aquarium or cage of comparable size is adequate. The cage bottom can be lined with straw or other natural material. Include two or three branches in the

cage for climbing. Introduction of solid foods can begin at this time. Baby cereals can be added to the formula and fed through the syringe. Baby foods (fruits and vegetables) can be provided in a shallow dish.

Five to Six Weeks

Continue adding solid foods, incorporating small chunks of fruit and vegetables. (See Appendix 1). Chunks should be small enough to handle but large enough to prevent choking or swallowing whole. Add pieces of Rodent Lab Chow™ (manufactured by Purina) which will eventually be the main component of the diet. If this pelleted food is refused on a regular basis, a high quality puppy kibble (Science Diet ™ or Iams™) can be used as a transitional food. Rabbit pellets *do not* provide the proper nutrition (e.g., too low in protein and too high in fiber) for rodents and should not be used. Rabbit chow may cause a mucoid enteritis due to the high fiber content when used in squirrels (Harkness & Wagner, 1983). Rodent chow will generally be accepted by most squirrels once the incisors have grown in completely. Solid food should be left in the cage at all times to encourage self-feeding. Replace any food that has not been eaten within 12 hours to prevent flies and bacteria from forming. The amount of formula consumed may decrease during this time as the kits begin to take in calories from the solids. Monitor behavior of the kits while eating to make sure one squirrel doesn't dominate the food dish, preventing smaller kits from getting their share.

Six to Eight Weeks

Kits will start caching behavior at approximately 7 weeks. Provide a few nuts every day that are partially in the shell so kits can practice cracking them. White Oak acorns are preferred over other nuts because of their palatability and soft shell. English walnuts can also be given. Filberts/hazel nuts are difficult to open until the squirrels are older but are also acceptable. Formula feedings can be decreased to two per day, at approximately 8 hours apart. Continue to offer solid foods at all times.

Eight to Ten Weeks

Start weaning off the formula during this time. Gray squirrels wean at 6-8 weeks while Fox Squirrels wean later (e.g., 10-12 weeks). Some kits will refuse the formula naturally. Their digestive system is changing so they cannot digest milk as easily. If they refuse the formula, don't force them to take it. Weigh kits daily to make sure they are receiving enough calories from the solid food. Some kits will continue taking the formula for one or two weeks. Rodent chow should comprise approximately 60% of the solid food diet. Fruit and vegetables should only comprise 25% of the diet at this time. Formula, nuts, leaves, flowers, bark and fungi should be limited to 15%. After juveniles stop consuming formula, the ratio of food items should be 60% rodent chow, 30% fruits/vegetables, and 10% miscellaneous nuts, flowers, etc. *Note: since citrus fruit is not a part of the natural diet, it should not be used. In addition, the high acidity of these fruits may adversely affect the gastrointestinal system of monogastric herbivores. Diarrhea can result when citrus fruit is given to squirrels.*

Nine to Twelve Weeks

Kits should be consuming solid food as their main diet by now. Formula should only be given as a supplement to ensure the animals continue gaining weight. Most squirrels are weaned by ten weeks. Smaller members of a litter may take a little longer. ALL squirrels must be weaned off the formula by twelve weeks of age.

Twelve to Sixteen Weeks

Nuts should be almost completely in the shell with only a small hole at one end when the squirrels are twelve weeks of age. Whole nuts (completely in the shell) can be given in addition to the partially cracked ones. Monitor their ability to crack whole nuts since this behavior must be observed before the squirrels are released. Offer Spruce buds, Pine cones and Fir cones to Douglas and Red Squirrels, in addition to the nuts.

Figure 2:
Comparison of Fox Squirrel Weight Gains Based on Formula Used

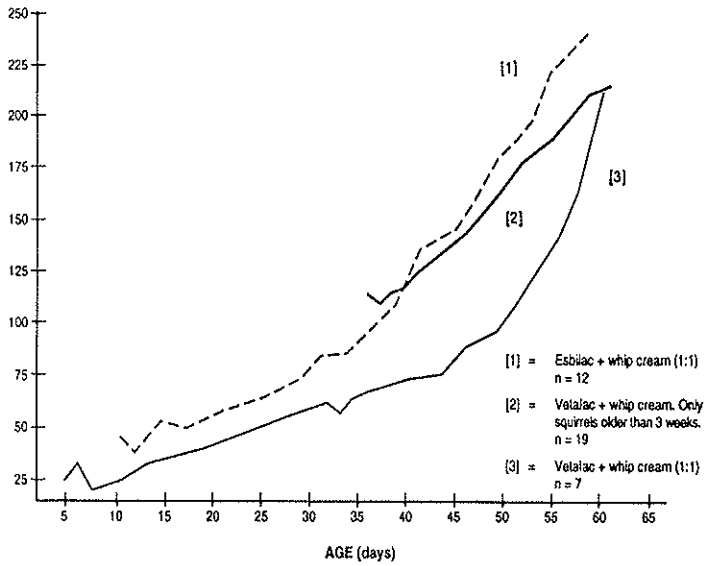


Table 2: Physical Development of Fox Squirrels from Birth to Sixteen Weeks of Age.

AGE	WEIGHT[1]	PHYSICAL CHARACTERISTICS[2]
Birth	14-18g	Looks like pink fetus. Eastern Grays have a grayish-white color.
0-1 Weeks	18-25g	Looks similar to pinkie mouse.
1-2 Weeks	25-35g	Dark fuzz on body appears.
2-3 Weeks	35-50g	Body hair coming in. Eyelids develop.
3-4 Weeks	50-85g	Short hair present. Looks like miniature squirrel. Eyes still closed. Lower incisors erupting.
4 Weeks	90-120g	Eyes start to open.
5 Weeks	120-150g	Eyes open and focusing. Upper incisors present.
6 Weeks	150-180g	Ear flaps stand up.
7 Weeks	180-200g	Begins digging, caching, nest-building, climbing, self/social grooming.
8 Weeks	200-230+g	Continues development of behaviors mentioned at 7 weeks.

INFANT DIET

The percentage of carbohydrates in Vetalac™ is extremely high compared to the Esbilac™ powder. The addition of HEAVY whipping cream (higher fat content than regular whipping cream) decreases the carbohydrate ratio as well as increases the total fat content.

Infant squirrels over the age of three weeks were fed the Vetalac™ based formula. Their weight gains were comparable to those fed the Esbilac™ formula. (See Figure 2). There was no indication of Metabolic Bone Disease (MBD), malnutrition or other health problems commonly associated with inadequate formulas.

Infants from birth to three weeks of age did not do as well on the Vetalac™ formula. Weight gains were lower than expected. In some cases, physical development (appearance of hair, eyes opening, eruption of upper and lower incisors) was delayed by up to 7 days. The explanation for this was unclear. The author suspects that there may have been a connection between the problems observed and an insufficient amount of protein in the diet. Sufficient amounts of protein are required for proper bone, muscle, tissue and nerve development. However, other factors related to general malnutrition could have played a role in the lower growth rates. After development of eyes, teeth, hair, claws, etc., there were no adverse effects from this formula. For that reason, Vetalac™ should probably not be the first choice for young animals that arrive at the age of three weeks old or younger.

Douglas Squirrels that were fed the Vetalac™ formula developed a loose stool. This problem was not associated with disease and was not noticeably helped when Pepto-Bismol® was administered. There was no indication of any adverse effects on the animal such as dehydration. However, loose stool left unchecked could develop into diarrhea which could lead to bacterial infections and dehydration. The loose stool cleared up shortly after the animals started consuming solid food. A conclusion could be made that the loose stool was, at least in part, caused by the Vetalac™ formula. Again, the problem could have been related to an insufficient amount of protein.

The Vetalac™ formula has an excess proportion of carbohydrates, so there is a possibility that the smaller species were more sensitive to that component and were adversely affected. That was a common problem in the 1970's and early 1980's when people fed squirrels Karo™ syrup (Spaulding, 1979). Loose stool was not observed in Fox, Eastern Gray, Northern Flying, California Ground Squirrels or Townsend Chipmunks of any age that were fed the Vetalac™ formula.

The Esbilac™ formula is commonly used by wildlife rehabilitators and can be obtained from most veterinary suppliers and pet stores. Heavy whipping cream can also be added to the formula to increase the total solids and fat content. Some rehabilitation centers have reported using just the Esbilac™ powder mixed with water. A comparison of the two formulas is given in Table 3A.

Weight gains were slightly higher when whipping cream was added to the formula (Stone, Fender 1985). In addition, smaller amounts of formula were given at each feeding because the caloric content was higher. That may decrease the occurrence of diarrhea from overfeeding or from the low solids content of the formula.

Table 3: Nutritional Comparison of Artificial Milk Formula Components

Based on percent fat, protein and carbohydrates of the total wet based formula, not dry weight.

	% solids	*% fat*	*% protein*	*% carb.*	*Kcal/ml*
Natural Eastern Gray Squirrel Milk	39.60	24.70	7.40	3.71	2.75
Formula #1					
1 part Esbilac™ Powder 1 part water 1 part HEAVY whipping cream *Lactobacillus*	33.75	22.64	6.43	3.84	2.53
	% solids	*% fat*	*% protein*	*% carb.*	*Kcal/ml*
Formula #2					
1 part Vetalac™ Powder 2 parts HEAVY whipping cream 1 part water *Lactobacillus*	38.29	24.14	4.86	7.43	2.75

Esbilac™ is manufactured by Pet-Ag. Vetalac™ is manufactured by Vet-A'-Mix and can be purchased through Wholesale Veterinary Supply in Rockford, Illinois. Formulas are based on information given in Pet-Ag publication, "Mother's Milk is Nature's Most Perfect Food."
Mathematical calculations were used to determine the values of the different artificial formulas.

Table 3A: Comparison of Several Esbilac™ Formulations

Formula	*% solids*	*% fat*	*% protein*	*% carb.*	*Kcal/ml*
Esbilac + water (1:1)	30.60	13.50	10.20	4.80	1.87
Esbilac + Heavy whipping cream + water (1:1:1)	33.75	22.64	6.43	3.84	2.53

Table 4: General Guideline for Formula Feeding, Based on Age

AGE		TIME	TABLE	NUMBER OF FEEDINGS/DAY
0-2	weeks	Every	1 1/2-2 hours, 24 hours a day	12-15
2-3	weeks	Every	2-3 hours from 6am-2 am	8-11
3-4	weeks	Every	3-4 hours from 6am-11pm	5-7
4-5	weeks	Every	4 hours from 7am-11pm	5-6
5-6	weeks	Every	6 hours from 8am-8pm	3-4
6-8	weeks	Every	8 hours	2

WORD OF CAUTION: *If the Esbilac/whipping cream formula is used for the very young infant, the animal should remain on that formula until it is weaned onto solid food.* ***DO NOT*** *switch from one formula base (Esbilac™) to another (Vetalac™) as the animal gets older. The result will be severe diarrhea from the abrupt change in diet.*

Squirrels of all species were fed the Esbilac™/whipping cream formula with good success. Very young infants (less than 3 weeks) had better weight gains and physical development than those fed the Vetalac™ formula (Figure 2). ***Editors Note:*** *The usual mixture of Esbilac™ (as per the manufacturer's directions) is also perfectly acceptable to use on squirrels. The author is reporting data on the diets she used.*

A squirrel formula based on Esbilac™ is preferred if that product is available on a consistent basis. In addition to its use with squirrels, it can be used with many other related species such as beaver and porcupine. Formulas based on Vetalac™ are not advisable for the larger rodent species because of the high carbohydrate content. Unfortunately, economic realities prevent some rehabilitators from using expensive formulas on a regular basis. Vetalac™ may be a feasible alternative to those people, if they receive many squirrels that are at least three weeks of age (most infant squirrels that find their way into rehabilitation centers fall into this category). If Vetalac™ is used, it must be stressed that Vetalac™ CANNOT be substituted across the board with Esbilac™ because they have different ratios of fat, protein and carbohydrates. Modifications must be made to the formula to make sure the nutritional components closely match the natural milk.

This schedule is only a guideline to indicate how much time is involved with caring for squirrels at any given age. There will always be differences between individuals based on metabolism, stomach capacity, species, calories in the formula and general condition of the animal. The time table range, especially in the very young infants, indicates how long animals can go between feedings without becoming weak from hunger. There can be more leeway in feeding schedules after the animals start actively eating solid foods. The number of feedings per day is given in a range to accommodate differences in metabolism and stomach capacity and is a better guideline for determining individual feeding schedules. If animals tend to gulp down food at each feeding (as if they are starving), increase the number of feedings by one or two per day. Animals that go too long between feedings and gulp down their food have a higher chance of aspirating formula into the lungs.

Weigh the animals daily and recalculate the caloric needs as they gain weight. Do not decrease formula amounts when animals lose small amounts of weight. Daily fluctuations normally occur and should not be of concern as long as the general trend over a period of two to three days is a positive weight gain.

Lactobacillus is listed under all of the formulas provided in this paper and should always be added to any milk formula given to squirrels. *Lactobacillus* is a genus of Gram-positive, nonsporeforming, rod-shaped bacteria found in milk, dairy products and in the intestinal tract of animals. The bacteria ferments lactose (milk sugar) to produce lactic acid. (Frobisher, et.al., 1974). The organisms that sour milk are inhibited by *Lactobacillus acidophilus, L.bulgaricus* and *Streptococcus thermophilus. Lactobacillus* spp. can tolerate a lower pH than the bacteria that sours milk. *Lactobacillus* compete for sites and help prevent overgrowth of other pathogenic enteric bacteria. The lactic acid produced by *Lactobacillus* and *Streptococcus* may help control the putrefying bacteria which may also be present (Frobisher,et. al., 1974).

Lactobacillus spp. are added to the milk formula to prevent souring of the milk in the intestinal tract and to introduce healthy colonies of microflora (beneficial bacteria) that will be required later, as the animal starts eating plant material. Products such as Bene-Bac™ (Pet-Ag) and Probiocin™ (Pioneer) contain several species of *Lactobacillus* and *Streptococcus* that can be easily added to the milk formula. They come in powder or gel forms. The amount added to the formula is based on the weight of the animal. Both of these products can be purchased from most veterinary supply companies. *Lactobacillus acidophilus* can be purchased in health food stores. It is manufactured for people with lactose intolerance. One-half to a whole capsule can be added to the formula to introduce this species into the intestinal tract. If purchased from health food stores, the product is commonly labelled Acidophilus.

Feeding Instruments

There are several articles available on the different instruments available for feeding infant mammals. Each rehabilitator should choose the one(s) that is best for them, based on ease of use, ease of cleaning and availability. There are some pros and cons to different products that will be discussed briefly in this paper.

Tuberculin syringes (1ml) can be used successfully for very young squirrels. A latex gavage tube or infusion cannula should be added to the tip of the syringe to allow smaller drops of formula to pass into the animal's mouth. (See Figure 1). This technique was a great help in reducing the incidence of aspiration into the lungs and/or nostrils. Aspiration usually occurs because too much formula is expressed into the mouth at one time. The animal cannot swallow it all without choking. Many times excess fluid goes up into the nostrils and is then inhaled. The fluid trickles

down the trachea and enters the lungs. Depending on how much formula is inhaled (in proportion to the size of the lungs), the animal may either die immediately from asphyxiation or die several days later from pneumonia.[3]

As the squirrels increase in size and consume 2-3 ml of formula per feeding, a larger syringe (3 or 5 ml) can be used, without the added gavage tube or cannula tip.[4] Continue to increase the size of the syringe to accommodate the amount of formula consumed at each feeding. The curve-tip syringe (12 ml) is very useful for older squirrels.

Syringes can be used several times, are affordable and easily obtainable for most people. They can be cleaned in soap and water and then soaked in a mild bleach solution to kill bacteria. Eventually the black rubber stopper on the plunger will dry out and stick when the plunger is pushed down. As soon as sticking is noticed, the syringe should no longer be used.

Other instruments available include pet nurser bottles. Some rehabbers report success with them; but there are several drawbacks to their use. Squirrels (and rabbits) have long, sharp incisors that can easily snip off the end of the nipple and swallow it. They are also not good for ground squirrels and chipmunks, which have cheek pouches. These animals tend to suck air into these pouches when they feed unless the feeding instrument is inserted far back into the mouth. Bloat may result in these cases.

Another problem with the pet nurser bottle is that it is difficult to monitor small amounts of formula taken because the increments on the side of the bottle are not as accurate as those on the syringe. In addition, the size of the nipple must be suited to the animal and to the thickness of the formula. Going from a diluted formula to straight formula to formula + baby cereal requires several nipples with different sized openings. (For nipple size discussion see White, 1989).

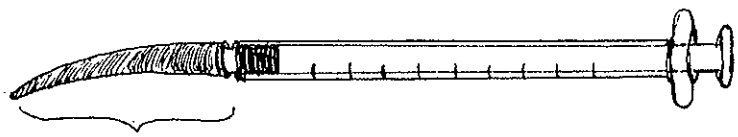
Another type of feeding instrument is the Catac™ nipple used with O-Ring™ syringes. This instrument was not used at Laurel Creek so data concerning the pros and cons was not available. For more specific information on Catac™ nipples, consult the article by Reese, 1991.

Rehydrating Formulas

It has been generally accepted by small mammal rehabilitators to start infants on an electrolyte solution (Pedialyte™, Ricelyte™, Lactated Ringers Solution (LRS) + 2 1/2% Dextrose or LRS + D5W) for the first 24 hours. The purpose of this is to empty the infant's stomach of the natural milk before introducing the new artificial formula. The formula is then diluted with one of the electrolyte solutions for a period of time while the animal adjusts to the new formula. There seems to be a difference of opinion as to how long the formula should be diluted. As with most other things, there is no one right answer. The age, species and condition of the animal will always supersede any set schedule. Some rehabbers take

Figure 1

Figure lA: Gavage Tube Attached to Tuberculin Syringe for Feeding Infant Squirrels.



orange latex
gavage tube*

*Drawn to scale

*Figure 1B: Infusion Cannula Attached to Tuberculin Syringe**



*Drawn to scale

up to one week to get the animals onto the straight formula. Others get the animal onto the straight formula within 48 hours.

The main problem associated with putting an animal onto straight formula too fast is intestinal upsets from the abrupt change in diet. Diarrhea usually results. At that point the animal must go back on to a diluted formula and remain on that until the diarrhea clears up. It usually takes two or three feedings before any improvement of the stool will be seen. After that the animal can gradually be put back onto the straight formula.

Problems associated with taking several days to get the animal onto straight formula are:

1) weight loss from lack of calories
2) diarrhea from giving a formula that doesn't contain the appropriate ratio of total solids
3) animals eventually compensate for lack of calories by eating more formula at each feeding which results in overfeeding and intestinal upset.

In this trial, healthy squirrels were put onto the straight formula diet over a period of three to four days. However, instead of using an electrolyte solution such as Pedialyte™, an amino acid solution was used as the diluent.

Amino acids are easily digestible forms of protein (i.e., they are the building blocks of proteins) and provide some extra nutrition until the animal starts consuming the straight formula. In addition to being a diluent for infant formulas, the Amino Acid Solution™ seems to be a good rehydrating formula for severely dehydrated or emaciated animals.

The Amino Acid Solution™ was originally used when a pair of infant Northern Flying Squirrels were presented to Laurel Creek. They had been fed a diet of Coffee-Mate™ non-dairy creamer for five days by a member of the general public. The squirrels were brought to us because they had diarrhea. Upon examination it was determined that they were severely dehydrated (12%+) and emaciated. Their condition was so bad that they were not expected to live through the night. After receiving subcutaneous fluids for 48 hours, my first thought was how to get some nutrition into these animals without severely stressing their gastrointestinal systems. Even though their general condition had improved, they appeared **too** weak to digest the formula. I knew an amino acid solution was commonly used in debilitated livestock and that very little energy was needed to absorb the nutrients. I decided to try the product with the squirrels; however, I diluted the manufactured product since the concentration was too strong for animals weighing 15g. The following recipe was developed and used with success. The two animals were successfully rehabilitated and released.

Recipe for Diluted Amino Acid Solution

3 parts Amino Acid Solution™ (manufactured for livestock)
3 parts Pedialyte™ or other electrolyte solution
1 part 50% Dextrose

The above recipe makes a solution that contains 0.36 Kcal/ml compared to 0.10 Kcal/ml in Pedialyte™ alone. In addition to some calories, this solution provides 11 amino acids, electrolytes and B vitamins. For debilitated animals the above solution can replace other oral fluids and can be given until the animal can take in nutrients from other sources that require more energy for digestion. For healthy orphans, the Amino Acid

Table 5: General Schedule For Making Transition From Natural Milk to Artificial Formula, Using Amino Acid Solution as the Diluent

DAY	FORMULA COMPONENTS		
1	Diluted Amino Acid/Pedialyte Solution only		
2	3 parts Diluted Amino Acid Solution 1 part milk formula	**OR**	2 parts Diluted Amino Acid Solution 2 parts formula
3	2 parts Diluted Amino Acid Solution 2 parts milk formula	**OR**	Straight formula (Watch for diarrhea for next 12 hours)
4	Straight formula		

Solution™ can be given alone during the first 24 hours and then used as the diluent with the milk formula until the animal can consume the straight concentration of formula. The diluted amino acid solution is a non-sterile, hypertonic solution and should only be given orally.

Diarrhea

Most commonly, diarrhea is caused by one or more of the following:

1) *Improper feeding technique*--generally, feeding too much too fast. Use of a gavage tube or an infusion canula on the tip of the syringe will usually solve this problem. Proper technique usually comes with practice.

2) *Feeding a diet that lacks the proper ratio of total solids or other components*—Diets that have excessive carbohydrates may also cause diarrhea. Always use a diet that closely matches the natural mother's milk. Esbilac™ or Vetalac™ powders should be used as the formula base. Heavy whipping cream or MultiMilk™ (Pet-Ag) can be used to modify the solids, fats, proteins and carbohydrates. DO NOT feed KMR™ kitten milk replacer or use it as the base formula with squirrels. The protein content of KMR™ is too high and the fat content too low for proper squirrel nutrition. Diarrhea will result from a KMR™-based diet. If the formula is incorrect, products such as Pepto-Bismol® or Kaopectate™ will not remedy the situation. Pepto-Bismol® only aids in problems associated with gastrointestinal upsets from problems such as abrupt changes in the diet. The incorrect formula must be changed to meet the needs of the animal before improvement of the stool will be seen.

3) *Bacterial/parasitic infections*—Bacterial enteritis can occur in squirrels that have been fed an inadequate diet for a long period of time (usually 5-7 days). Cow's milk, generally given by the unknowing public, is usually the culprit. Depending on the severity of the case, death may occur no matter what is done to solve the problem. White diarrhea, accompanied by hypothermia, dehydration (10%+) and emaciation have a poor prognosis. In animals that are in fair to good condition, rehydrating solutions and subcutaneous fluids should be given to stabilize the animal. The Amino Acid Solution™ can be given orally to give the animal some easily digestible nutrition. A proper formula should be introduced gradually. Coccidiosis can occur in squirrels 8 days of age or older. See information in section on Health Problems for treatment.

4) *Side effects of antibiotic therapy*—Infant squirrels are particularly sensitive to the effects of broad spectrum antibiotics that may be used to treat lacerations or other external injuries. The antibiotic, along with killing pathogenic bacteria, will kill the beneficial intestinal bacteria needed to digest food. Extreme caution should be used in antibiotic therapy. Many times alternative methods for treating injuries are available without the use of antibiotics. A veterinarian should be consulted for more information on alternative methods and on antibiotics that do not adversely affect the gastrointestinal system. *Lactobacillus* spp. should always be added to the diet when antibiotics are used to counter some of the adverse effects.

INFANT HOUSING

Infant squirrels can be housed in 5-10 gallon aquariums from birth to four weeks of age. Place a heating pad under one-half to two-thirds of the tank. Pillow cases make good flooring at this time. After the eyes open (4 weeks) the squirrels can be moved into a 15 gallon aquarium or cage of equivalent size. The height should be restricted to approximately two feet tall because the squirrel's balance is not fully developed at this time. The heating pad is no longer required for healthy squirrels. Bedding of either commercial or natural material (pine shavings, leaf litter, soil) can be used for the flooring.

Baby squirrels should be kept in groups of 2-5 animals per enclosure. If entire litters are received, they should be kept together as long as they don't become overcrowded, at which time they can be separated into smaller groups (5-6 weeks of age). Most rehabilitators receive single or paired orphans. For these cases, try to get them into groups of other singles or small litters. Four to five squirrels under the age of three weeks help keep each other warm and provide a sense of security. As they get older and start moving around, they can be separated into smaller groups. The ideal group size is three. Always house at

least two infants or juveniles together. Single squirrels don't develop social/survival skills as easily or as quickly as squirrels housed in groups.

By five weeks of age squirrels can be housed in enclosures 3'L x 3'W x 3'H. Several tree limbs should be positioned at different heights and angles so the squirrels can develop their climbing muscles and improve their sense of balance. Also provide two or three nest boxes made of cardboard or wood. Dryer lint acts as a good nest material. Continue using natural materials for flooring.

By eight weeks of age the squirrels can be moved to an outdoor enclosure during the day when it is warm (above 65°) and dry. This area will become their main exercise area so should be furnished with components of the squirrel's natural habitat (branches including leaves or fir boughs, decaying logs, etc.). Ideally the cage should be 6'L x 4'W x 6'H. The cage floor should contain some kind of natural material such as straw, leaf litter or soil. A water bottle should be hung on the side of the cage or heavy ceramic dish containing water placed on the floor. Attention should be paid to providing shelter from weather and backyard predators. Double doors are good protection from escape attempts.

By twelve weeks of age the kits should be able to stay outside in a partially covered area at all times. Spend as little time as possible with the squirrels so they develop a shyness to people. Feeding time should be the only time they see you. Feeding chutes may be employed to deliver food to reduce the human interaction and break associations between humans and food presentation.

HEALTH PROBLEMS

1. **MANGE** - Can be caused by *Sarcoptes scabiei* or *Notoedres cati* mites. Sarcoptic mange, commonly called scabies, attacks areas of the body with thin layers of skin. Extremities, groin and areas of the face are most affected. Alopecia (hair loss) due to intense itching, redness of the skin and small pustules that may form crusty areas are the most notable signs. Fever may also occur.

Notoedric mange, commonly called head mange, mainly occurs on the head, face and neck, although other areas may be affected because of grooming behaviors. Partial alopecia may occur, but is not as severe as in sarcoptic mange. Pruritis (intense itching) may be seen in both types of mange.

Diagnosis: Skin scrapings placed in a drop of mineral oil on a microscope slide and viewed microscopically at low magnification will differentiate the two genera of mites. The *Notoedres* mite resembles *Sarcoptes* but has a slit-like anus located subterminally rather than terminally on the dorsal surface of the abdomen. (Haveman, 1988)

Treatment: For both types of mange, Ivermectin (Ivomec™ .27% injectible) is the treatment of choice. Administer 0.05 ml/lb. subcutaneously. Animals can be dipped in LymDyp™, a 97.8% sulfurated lime solution commonly used to treat sarcoptic manage in dogs. Mix a 1:32 dilution (1 part LymDyp™ to 32 parts water). Pour on the affected animal (avoiding eyes and mouth) every 5-7 days until condition clears up (usually 2-3 doses). Both forms of mange are very contagious to many species of animals, including humans. Animals being treated for mange should be separated from all other animals and strict cleaning rules enforced.

2. **EAR MITES** - Caused by *Psoroptes cuniculae* in squirrels and rabbits. Mites puncture the skin and feed on serum in and around the auditory canal. There is a local inflammation, pruritis and exudate of serum which forms a crusty scab. Large open sores near the ear are common because of scratching.

Diagnosis: Can be made by putting a few drops of mineral oil on a cotton swab. Introduce the swab into the external auditory canal and gently rotate it to pick up the mites (Sloss, 1978). Live and dead mites may be seen with a hand-held magnifying glass. The swab may also be rubbed in a drop of mineral oil on a microscope slide and viewed microscopically at low magnification.

Treatment: Clean external auditory canal with a chlorhexadine wash such as Nolvasan Otic™. Follow the cleaning with drops of Mitox™ or other ear mite medication suitable for rabbits. Daily cleaning and treatment will be necessary until mites (dead or alive) are no longer observed.

3. **COCCIDIOSIS** - Parasitic disease caused by the protozoan *Eimeria*. Coccidia is species-specific so squirrels can only contract it from or transmit it to other squirrels. Transmission is generally from feces contaminated food/water. It is also naturally present in the soil. In *healthy* adults it is generally self-limiting. One study indicated that 90% of squirrels harbored *Eimeria* oocysts (encapsulated paired zygotes that pass in the feces). (McAllister, Upton, 1989). After the primary exposure the squirrel develops some protective immunity so subsequent exposures are usually not pathogenic (Schmidt, 1989).

Animals that are under a lot of stress may develop diarrhea containing *Eimeria* oocysts (diagnosed by fecal float). If the animal appears in good health, apart from incoming injuries (active, eating well, maintaining weight), no treatment may be necessary. If the diarrhea continues for 24

hours or more, PeptoBismol® or Kaopectate™ can be administered to prevent dehydration (from diarrhea). Animals with bloody diarrhea, which are lethargic and/or anorexic are suffering from pathogenic coccidiosis and should be treated.

Treatment: Albon™ (contains 250mg/tsp. Sulfadimethoxine) can be administered at an initial dose of 25mg/lb and reduced to 12.5mg/lb for subsequent doses until the diarrhea clears up.

Infants are at a higher risk of disease from *Eimeria* since they haven't had a previous exposure to the protozoa. The minimum prepatent period is 7 days. Animals younger than this age that are suffering from diarrhea will not have coccidia. (Haveman,1988). Albon™ should administered to infants or juveniles ONLY after a confirmed diagnosis has been made.

4. **ASCARIASIS** (from *Baylisascaris Procyonis)* - Infection from the raccoon roundworm. Raccoons pass ascarid eggs in their feces. The eggs, while on the ground, will develop to the infective larval stage, called embryonated eggs. Squirrels (and other rodents/rabbits) can ingest these infective eggs while foraging for food. The squirrel then acts as the paratenic host for this parasite. After ingestion, the larvae break out of the egg capsule and migrate to various tissues and to the central nervous system. Brain damage, paralysis and death occur. Infection from *B. procyonis* can mimic the signs of rabies, tetanus and CNS trauma (Nance, 1986). After the squirrel is disabled or killed in the wild, the raccoon may consume the carcass, as well as the infective larvae. In general, the raccoon is not adversely affected by the parasite since it is the definitive host.

Because of the fatal consequences to squirrels, they should not be housed in the same general area as raccoons. Humans tend to act as the vector for the roundworm when they clean raccoon pens and get the parasitic eggs on their shoes, clothes and hands. The microscopic eggs are then easily transferred to squirrel enclosures. Nothing short of a blow torch kills the eggs and they can live in the environment for years. All raccoons should be dewormed at intake with Ivermectin™. There is no treatment available for infected rodents and rabbits. Positive diagnosis can only be made from the presence of larvae in tissue samples.

5. **ABSCESS** - Many squirrels develop abscesses from natural sources (getting poked by branches) and unnatural sources (cat bites). Treatment should be based on the size of the abscess, whether it is localized or spreading, and the general condition of the animal. In the case of squirrels, age is also a factor. The following is a case history and treatment of several squirrels with abscesses at Laurel Creek.

Five adults in the study group had small (pea-sized) abscesses on knuckles of front paws, heel of hind feet and groin. All of the animals appeared in good health (eating well, active, and maintaining weight). Two of the squirrels also suffered from spinal trauma. Because the animals appeared healthy and exhibited no obvious signs of infection, the decision was made NOT to treat the abscesses with broad spectrum antibiotics. Within seven days the abscesses on two of the squirrels had re-absorbed without rupturing. In the other three cases, the abscesses had opened and were self-draining. It was not determined whether the squirrels scratched/bit at the sores or if they struck some object in the enclosure that caused them to rupture. In either case,the abscesses drained on their own and healed completely. All five animals remained in good health (excluding the spinal trauma) and showed no adverse effects from the lack of antibiotics.

In cases where the animal is in good health and the abscess is pea-sized or smaller and remains localized, antibiotics may not be necessary. However, if large abscesses are observed or the animal shows signs of systemic infection (fever, weight loss, etc.), a veterinarian should be consulted for further treatment.

Four infants, less than three weeks old, were also presented to Laurel Creek with abscesses in the groin area and hind legs. In all four cases there was a history of cat attack. Young herbivores (especially rodents and rabbits) are particularly sensitive to broad spectrum antibiotics (they kill the microflora which results in mucoid enteritis and death). Because of this, the decision was made NOT to use antibiotics in these animals. The abscesses, which were pimple-sized (less than 1.5mm in diameter) were lanced with a sterile needle. Small amounts of pus were expressed from the area several times until the core of infection was removed. Nitrofurazone ointment (0.2%) was applied to the area to prevent a scab from forming. Triple antibiotic ointment (containing Bacitracin, Neomycin and Polymyxin-B) also could have been used. The wounds were closely monitored for signs of further infection. After the core of infection was removed, the wounds healed completely within seven days. No other infection occurred.

Broad spectrum antibiotics are not tolerated very well by infant and juvenile squirrels. With small, isolated abscesses in animals that otherwise appear healthy, treating the wounds topically may be an alternative method. With large, severely infected abscesses in animals

showing signs of systemic infection, the protocol may not be appropriate. A veterinarian should be consulted about alternative treatment, including the use of antibiotics that will not adversely affect the gastrointestinal system. If antibiotics are used, *Lactobacillus* spp. in the form of Bene-Bac™ or Probiocin™ should be added to the diet to introduce additional colonies of intestinal microflora.

6. **HEAD/SPINAL TRAUMA** - most common injury seen in adult squirrels. Caused by collisions (with cars), falls and animal attacks. Signs include: head tilt, ataxia (lack of muscle coordination), paralysis of hind legs, nystagmus (twitching of the eyes associated with head tilt) and bleeding from any orifice, indicating possible hemorrhage.

Treatment: Animals should be treated for shock during the first 24 hours (Fluids, heat, steroids). Antibiotics may not be needed in mild cases unless external injuries (lacerations, puncture wounds, compound fractures) are present. After 12-24 hours the animal should be tested for deep muscle reflex (by the pinch test). If no reflex is present, the likelihood of permanent damage is high. Radiographs may be taken for further diagnosis. If there is severe or irreparable damage, euthanasia may be the best solution.

Sulfonamides, such as Tribrissen™, or Chloramphenicol are antibiotics that are particularly useful with head/spinal trauma injuries where infection is a concern. These antibiotics are known to penetrate the central nervous system. These antibiotics have a few side effects related to the gastrointestional system. Commonly used dosages of these drugs for squirrels are: Tribrissen™ (24% injectable Trimethoprim/ Sufamethoxazole) 30mg/kg SQ q 24 hours (or 15 mg/kg SQ q 12 hours) for 3-5 days, Chloramphenicol palmitate 25 mg/lb PO q 6 hrs for 3-5 days. Both of these drugs can be used in conjunction with Dexamethasone.

If deep muscle reflex IS present, the prognosis is favorable. The animal should be monitored for the next 7-10 days. The bladder will need to be expressed periodically through the day if there is paralysis of the hind legs. Urination must be closely monitored in these cases. During the initial ten days, improvement regarding paralysis, balance and bladder control/urination should occur. Radiographs may be taken for further diagnosis if improvement does not take place. Euthanasia may be the best solution if the chance for a full recovery is doubtful.

Animals recovering from spinal/head trauma should be housed in a cardboard box or 10 gallon aquarium. If the aquarium is used, line the sides with 1/2" or 1/4" foam rubber padding (carpet padding). Place padding in a pillow case to aid in cleaning and to prevent chewing. These animals have difficulty maintaining their balance and tend to knock against the hard glass surface. The padding helps prevent further injury. The padding can also be used inside the cardboard box but isn't as critical.

Squirrels, along with most rodents and rabbits are anatomically designed to engage in coprophagy ("feces-eating") (Schmidt-Nielsen, 1984). They, under certain environmental conditions, may reconsume partially digested food to absorb B vitamins from plant material. This behavior is more likely to occur when fed a diet high in cellulose as opposed to their normal diet which includes many highly digestible seeds.

This behavior is similar to ruminants that belch up a cud and re-digest it for nutrients. The squirrels take the "cud" (which is in pelleted form) directly from the anus. If the animal is paralyzed in the hind limbs or otherwise incapacitated so it cannot sit on its haunches, it will not be able to reconsume its food. As a result, the squirrel may develop a B-vitamin deficiency. Brewer's Yeast, a concentrated source of B vitamins, is an inexpensive way to provide these vitamins. Some of the B vitamins are associated with the nervous/muscular system, so the addition of B vitamins to the diet may assist in the regeneration of nerve function damaged from the injuries. (Whitney, Hamilton, Rolfes, 1990).

RELEASE

Squirrels can be released anytime after 15 weeks IF they exhibit the following behaviors:

1. Crack whole nuts
2. Food caching
3. Climb branches easily and are able to balance on limbs at different heights.
4. Make nest from provided materials
5. Eat natural foods such as bark, moss, leaves, seeds, fungi.
6. Shy away from humans and domestic pets.
7. Are fully acclimated to the weather.

At Laurel Creek squirrels are housed in a cage 8'L x 10'W x 6'H for the last two weeks before release. The cage is situated in a wooded area of the center that is a mixed forest. The enclosure has a natural soil floor containing small growing plants. There are several deciduous and coniferous branches spread out in the enclosure to allow for climbing and jumping from one tree to another. (Flying squirrels are also housed in this enclosure

and they must practice using their parachuting skills.) Several nest boxes are hung on the sides. Food is placed in small pouches and also hung on the sides of the enclosures, near tree branches. This simulates where natural food would be found and encourages the behavior to look for food in trees rather than on the ground. When the squirrels appear to be ready for release (see above criteria list), the cage door is opened and the animals are allowed to leave when they are ready. In the case of injured adults, they usually leave within a few hours and enter their natural habitat. In the case of juveniles that are raised from infancy, they may take several days to leave completely. Supplemental food is always provided for a period of time after the animals leave to help them during the transitional period from captivity to total freedom. This gradual release process has been quite successful, especially with juveniles that need a little more time to psychologically break away from total care and security found in captivity.

If a gradual release process is not possible, *Sciurus* species should be released in deciduous forests that have several nut trees (oak, walnut, filbert) available. Fox and Eastern Grays can live in high densities, so the presence of other squirrels at the release site may not be a deterrent.

Douglas and Red Squirrels should be released in coniferous forests that are predominantly Fir or Spruce. These species are low density animals, meaning that they need a lot of space. As stated earlier, they are territorial so they will aggressively push newcomers out of an established territory. New squirrels should not be released in an area where Douglas or Red squirrels are visibly observed. Also, the presence of dreys (tree nests) and middens (food storage areas) indicate an established territory.

Footnotes:

1. *Tamiasciurus* species weigh less at the ages mentioned but development of physical char acteristics should occur at approximately the same age.
2. At birth, chipmunks have faint dark dorsal and lateral stripes. Flying squirrels have *obvious* flaps of skin called "patagia" that connect the front and rear legs.
3. Aspiration of formula most commonly occurs in chipmunks and very young/small squirrels.
4. A curved-tip syringe or syringe/cannula should always be used with ground squirrels and chipmunks. Because they have cheek pouches, air is easily sucked into them when they nurse on a short-tipped syringe or pet nurser. Bloat commonly results.

Appendix 1: SUMMARY OF SQUIRREL DIET

60% - Rodent Lab Chow™ (Do not feed rabbit pellets to rodents)
30% - Fruit* and Vegetables

apple
grapes
watermelon + seeds
pumpkin + seeds
berries

*NO CITRUS FRUIT

sweet potato/yams
carrots + tops
spinach
celery tops
corn
peas
greens (mustard, collard, dandelion)
broccoli
alfalfa sprouts
mushrooms

10% Nuts and Seeds**

***Sciurus* species**	***Tamiasciurus* species**
White Oak acorns	Beech nuts
Black Oak acorns	Scotch Pine cones, Norway Spruce, Lodgepole Pine,
Hazel nuts/Filberts	Western Hemlock
English walnuts	Douglas Fir cones

***Do not feed sunflower seeds, peanuts, almonds or other nonnative nuts. Most of them are very high in fat. In the case of sunflower seeds, they are deficient in the amino acid Lysine, which prevents the full absorption of calcium. Peanuts are deficient in Methionine. Both of these amino acids are essential in rodents [Sheldon, 1971]. A diet rich in sunflower seeds can cause Metabolic Bone Disease (MBD). Alopecia and osteomalacia in captive flying squirrels was directly attributed to a diet rich in sunflower seeds and peanuts [Sheldon, 1971].*

Appendix 2: SUMMARY OF HOUSING NEEDS FOR SQUIRRELS, BASED ON AGE

AGE	ENCLOSURE SIZE
Birth - 2 weeks	5 gallon aquarium or cardboard box. Place heating pad (set on LOW) under two-thirds of box.
2 - 4 weeks	10 gallon aquarium or box of comparable size. Provide heat under one-half.
4- 5 weeks	15 gallon aquarium or cage with wire sides with dimensions: 2'L x 2'W x 2'H. Heat under the enclosure is no longer necessary for healthy squirrels. Provide branches in cage for climbing.
6- 8 weeks	Cage with wire sides (1/2" chicken wire, hardware cloth or comparable material) in the approximate dimensions: 3'L x 3'W x 3'H.
8-12 weeks	Cage of approximate dimensions: 6'L x 4'W x 6'H. Squirrels can be outdoors during this time. Cover part of enclosure to protect squirrels from the weather. Floor substrate should be of natural materials: straw, leaf litter, soil.
12 weeks - Release	Minimum cage dimensions of 6'L x 4'W x 6'H. Juveniles can be housed in groups of two or three.
Adults - Release	Adults should never be housed together, especially ones of the same sex. All species can become territorial in small spaces such as cages.

Products List:

Amino Acid Solution™ is manufactured by AgriLabs and is available through Wholesale Veterinary Supply in Rockford, Illinois. A free catalog is available by calling 1-800-435-6940.

Esbilac™ and KMR™ are manufactured by Pet Ag. Inc. 30W432 TR. 20, Elgin, IL 60120 and are sold at pet stores and veterinary supply houses.

Pepto-Bismol® is Bismuth Subsalicylate (1.75%) Total salicylate = 130 mg/Tblsp. The dose is 20 mg/Kg BW. Proctor & Gamble, Cincinnati, OH 45202 (1-800-543-7270).

LymDyp™ is manufactured by DVM in Miami, FL. (1-800-367-4902). It is sold through suppliers such as Burns.

Rodent Laboratory Chow™ #(05001) in manufactured by Purina Mills In.c. P.O. Box 66812, St. Louis, Mo. 63166-6812.

Science Diet™ is manufactured by Hills Pet Products, a division of Colgate-Palmolive, P.O. Box 148, Topeka, KS 66601. (1-800-445-5777)

Vetalac™ is manufactured Vet A Mix and can be purchased from Wholesale Veterinary Supply. (800-435-6940)

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Glossary:

alopecia — absence or loss of hair
anorexic — having no appetite
bloat — distention and enteritis; pertains to the stomach or cecum
BW — body weight
CNS — central nervous system
coccidia — parasitic sporozoa commonly found in epithelial cells of the intestinal tract
definitive host — the host in which the infectious agent goes through the sexual stage of its development and reproduction
dorsal — toward or on the back, the surface facing away from the ground, or the opposite of the ventral surface
enteritis — inflammation of the intestinal mucosa, resulting in diarrhea, abdominal pain, and dehydration
exudate — fluid with a high content of protein and cellular debris which has escaped from blood vessels and has been deposited in or on tissues; usually as a result of inflammation
fecal float — method with which to determine types and numbers of intestinal parasites from samples of feces
Gram negative — bacteria which do not retain Gram's stain, showing as pinkish-red in color
Gram positive — bacteria which, when stained with Gram's stain, retain the stain within the cell, showing up as bluish-purple in color
Kilojoules (Kj) — one thousand joules; one kcal is equal to 4185.5 joules
Lactobacillus — gram-positive, nonmotile, rod-shaped bacteria that do not produce spores and are acid resistant; produce lactic acid from carbohydrates, and are responsible for souring of milk
lateral — pertaining to the side
lethargic — sluggish
metabolic bone disease (MBD) — a range of bone diseases associated with metabolic cause, such as rickets and osteoporosis
monogastric — having a single stomach compartment, as opposed to polygastric, ie., ruminants
mucoid enteritis — irritable colon syndrome; frequent passage of soft to watery feces, often with mucus, caused by stress and psychological factors
osteomalacia — disease marked by softness of the bones, so they become flexible and brittle, causing deformities (adult form of rickets)
paratenic host — a host that is not essential for the completeion of a parasite's life cycle but it is used as a temporary habitat or as a means of reaching the difinitive host.
pathogenic — pertaining to the ability to produce disease
prepatent period — period between infection of the host and the earliest time at which the causative agent can be detected and recovered from the patient
protozoan — a type of unicellular organism
pruritis — itching, common in skin disorders such as allergic reactions and parasitic infestations
***Psoroptes* cuniculae** — a genus of mange mites commonly found on the ears of rabbits, goats, horses, donkeys, and mules
SQ q 24 hrs; q 6 hrs — subcutaneous injection every 24 hours; every 6 hours
subcutaneous fluids — injection of electrolytic fluids beneath the layers of the skin; commonly used method for rehydration
subterminally — pertaining to close to the end of an extremity
terminally — pertaining to or placed at the end
thermoregulate — to regulate temperature, especially body temperature
zygote — cell produced by the union of two gametes (mature reproductive cells); the fertilized ovum

Author Profile

Kerrin Grant is the Director of the Laurel Creek Wildlife Center. She received a Bachelor of Science degree in Biology (with an emphasis in Parasitology and Wildlife Science) from Portland State University in 1992. Kerrin worked for two years as a Veterinary Technician/Euthanasia Technician at the Oregon Humane Society. She took classes in Veterinary Technology Program at Portland Community College (PCC) 1988-1989.

She has worked as an animal management volunteer and as a relief zookeeper at Washington Park Zoo. Her zoological work has been with African hoofstock, Alaskan mammals, primates, Penguins, African and North American birds and waterfowl. She has also worked for two years as a Lab Technician at the Department of Environmental Quality (DEQ) in Water Quality Department.

She presently volunteers with Oregon Department of Fish and Wildlife. Her Projects include: Osprey census; duck banding; wildlife rescue and transport; and beaver relocation.

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Intraosseous Fluid Administration Utilizing the Avian Femur

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ABSTRACT

Intraosseous catheterization is a new method of gaining vascular access that can be life-saving. While it requires proper training and some equipment, it is a method that can be useful for wildlife rehabilitators. This article describes the technique in avian patients and details indications and contraindications.

KEY WORDS: Fluid therapy; intraosseous catheterization; avian veterinary medicine

Introduction

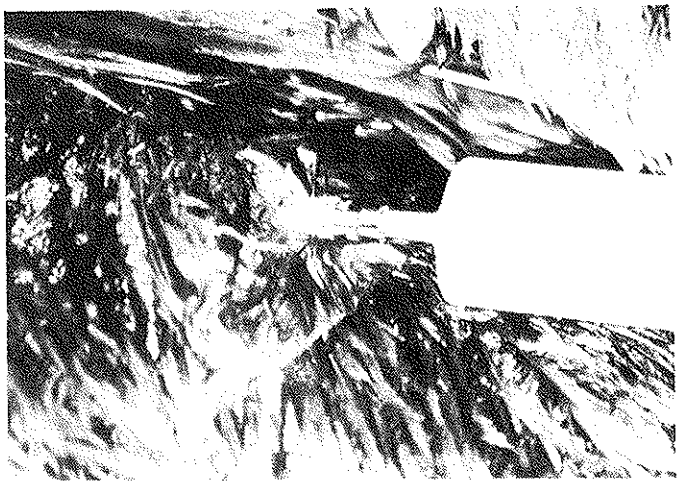
Intraosseous catheterization (IO) has been used in human medicine as a way of obtaining vascular access when venous catheterization can not be accomplished. It is accepted as a safe and effective procedure with few complications. It is most frequently used in infants and small children when low blood pressure and small veins make catheterization difficult. In human medicine, catecholamines, whole blood, calcium, antibiotics, heparin, lidocaine, and many other medications have been successfully infused by the intraosseous route without complications (Hodge, 1985).

Recently there has been an upsurge of interest and a number of articles in the veterinary literature about the applications of intraosseous fluids in veterinary medicine (Otto, 1989). This is especially meaningful to those of us who work in avian medicine.

Maintaining intravenous catheters in birds is frequently not possible. Our patient's small size, fragile superficial veins and lack of surrounding tissue for stabilizing and maintaining intravenous catheters has frequently left us with the options of using subcutaneous fluid therapy or intermittent bolus IV fluid therapy (Redig, 1984). Neither of these methods are as beneficial as continuous infusion fluid therapy and both require repeated handling and place additional stress on the patient. Placing an intraosseous catheter allows continuous infusion fluid therapy and permits us to minimize handling stress.

Indications and Uses

Intraosseous catheterization is appropriate whenever you would be considering IV fluid use if the patient was mammalian. It is indicated in cases of emaciation and dehydration, toxemia, shock, infection and septicemia, and trauma and blood loss. These are common problems in rehabilitation. Intraosseous catheters can also be used to administer blood transfusions, antibiotics and other medications.



A 2cm square area of skin overlying the trochanter was plucked and aseptically prepped. An 18 gauge spinal needle with a trocanter needle was inserted into the femur by placing the point against the trochanter with the needle in line with the femur and then rotating the needle with pressure to drive it through the cancellous bone and into the marrow cavity.

After the needle was inserted the placement was checked by removing the trochanter and injecting saline, checking for resistance or development of subcutaneous fluids. A drop of tissue adhesive Vet-Bond™ was applied to the needle hub to help stabilize the catheter. An infusion cap was placed on the catheter and a piece of Tegaderm™, a sterile adhesive dressing, was applied to help stabilize the catheter and maintain cleanliness.

When an intraosseous catheter is placed it provides rapid access to the venous circulatory system via the capillary-rich bone marrow. Additionally, in a shocky or hypovolemic patient, vessel collapse is prevented by the rigid support of the bone. The fluid dynamics of intraosseous infusions in pigeons have been studied (Lamberski and Daniel, 1992). Using a gamma camera to trace the uptake and distribution of a radioactive agent infused into the ulna, they concluded that, in pigeons, movement of material from the ulna into the systemic circulation was rapid and effective.

Application and Results

I have used IO fluids in quite a few individual cases with variable results, but no complication from the IO catheters. At the *American Trader* oil spill (1990) we used IO catheters in a group of 13 Brown Pelicans (White, 1992). These birds were started on IO fluids because they were severely debilitated and not responding to more traditional treatments. We were unable to correct their dehydration using IV bolus and subcutaneous fluids. The birds were in bad shape and frequently heavily oiled when the catheters were placed. We did have complications with osteomyelitis, which I had not seen in previous cases, but we were not working in the cleanest conditions, and many of these birds had IO catheters in place for 1-2 weeks using multiple sites. Of the 13 birds treated with IO fluids 7 survived and 5 were released. In pelicans we were able to visually monitor and control fluid administration rate with a marked bag. In smaller birds it is necessary to use either an infusion pump or a burette in the administration line so that fluid rate and amount can be closely controlled.

Previous literature on the use of intraosseous catheters in avian patients has advocated the use of the proximal ulna as a catheter site (Richie, 1990). I have found that I prefer the proximal femur because the bone is straighter, making catheter placement easier and the marrow cavity is larger making the catheter easier to insert. The catheter remains in place without additional stabilization such as a wing wrap. Another important consideration is that the location of vascular, marrow rich bones vs pneumatic bones is variable among avian species. In Brown Pelicans it appears that the ulna is a pneumatic bone and the femur is the only vascular bone in the appendicular skeleton (Siperstein-Cook, 1992).

Most of our intraosseous catheters were placed in the proximal femur. A 2cm square area of skin overlying the trochanter was plucked and aseptically prepped. An 18 gauge spinal needle with a trocanter in place was used. The needle was inserted into the femur by placing the point against the trochanter with the needle in line with the femur and then rotating the needle with pressure to drive it through the cancellous bone and into the marrow cavity. After the needle was inserted the placement was checked by removing the trochanter and injecting saline, checking for resistance or development of subcutaneous fluids. An additional check can be done by rotating the femur and watching the catheter hub move with the bone. A drop of tissue adhesive Vet-Bond™ was applied to the needle hub to help stabilize the catheter. An infusion cap was placed on the catheter and a piece of Tegaderm™, a sterile adhesive dressing, was applied to help stabilize the catheter and maintain cleanliness. The catheters were maintained in place in large part by the length of the needle within the femur.

Most of the pelicans treated with intraosseous catheters were maintained on continuous drip fluids and intraosseous antibiotics. Catheters were maintained in place for 3-5 days and if treatment needed to be continued, replaced, usually with a new intraosseous catheter in the contralateral femur.

Summary

We did see a number of birds which developed increased WBCs which may have been due at least in part to catheter-related infections. One pelican was euthanized due to a pathologic femoral neck fracture secondary to osteomyelitis of the femur. The procedure is not without risks, but it also had some very beneficial results. Of 13 birds admitted in very bad condition and given very poor prognosis, 7 survived and 5 were released.

In cases where IO catheters have been kept in place for 2-3 days I have not seen any catheter-related complications. This is a simple, practical technique with many applications. It can be used to greatly improve the supportive care we provide when starving, dehydrated, debilitated or severely injured birds are presented to us.

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Product List:

Spinal Needles, Becton Dickson & Co., Becton Dickinson Division, Franklin Lakes, NJ 07417
Vet-Bond™ Adhesive,3M Animal Care Products, St. Paul, MN
Tegaderm™ Transparent Dressing, 3M Animal Care Products, St. Paul, MN

Glossary:

appendicular--pertaining to the limbs
aseptically--free from infection or septic material
bolus--concentrated mass of pharmceutical preparation or fluids
cancellous--the reticular, spongy or lattice-like structure of bone tissue
catecholamines--any of a group of sympathomimetic amines (including dopamine, adrenaline or noradrenaline)
intraosseous--within the bone
osteomyletis--inflammation of bone due to a pyogenic infection
pneumatic--pertaining to air or respiration
proximal--nearest to a point of reference
septicemia--systemic disease of pathogenic microorganism or their toxins in the blood
subcutaneous--beneath the layers of the skin
trochanter--a tuberosity (bump) at the proximal end of the femur.
vascular--pertaining to the blood vessels

Author Profile

Janna Wynne is a 1989 graduate of the School of Veterinary Medicine at UC Davis (CA). She currently is in private practice at Studio City Animal Hospital in southern California.

Janna was a wildlife rehabilitator prior to becoming a veterinarian. She gained experience by volunteering or being employed at various wildlife centers in California. These included: Wildlife Waystation, The Marine Mammal Center, Shasta Wildlife Rescue and the UC Davis Raptor Center.

Janna is an IWRC advanced skills seminar instructor and lectures on fluid therapy and wound management.

Information Needed on Captive Marbled Murrelets

From the Pacific Seabird Group Bulletin Vol. 20 # 1

A subcommittee of PSG is requesting information for guidelines on documentation, care, and release of grounded Marbled Murrelets. We would appreciate information on weights, measurements (unflatted, flattened or maximum flattened wing chord; tarsus; culmen or exposed culmen (please specify which), fat, status (i.e., general health if live, body condition if dead), situation of captivity (if relevant), date, and location of nestling, fledgling or juvenile Marbeled Murrelets. We are also interested in the same information for adult murrelets that have been found at inland sites or have been in captivity. Please send any information you have to us at the address below. Be sure to include the appropriate citation as we would like to include a table of this information in the guidelines to be used as release criteria for captive murrelets. We would also appreciate any records of Marbled Murrelets in captivity and a contact person for obtaining details of each record (if possible) and the names and addresses of any others who are interested in contributing to the guidelines. Thank you for your help.

Nancy Naslund
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US Fish & Wildlife Service
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Book Review

"Health and Management of Free-ranging Mammals"

***OIE Scientific and Technical Review* Vol. 11(4) & 12(1)**
Office International des Epizooties
12, Rue De Prony
75017 Paris, France
Vol. 11 (4) 248 pp. US $34
Vol. 12 (1) 312 pp. US $40
Published March 1993;
(prices include air mail to US)

Ever wonder what wildlife scientists are doing outside of the United States? Well, we really should find out. As many of you know, it was the Europeans who led the way in dealing with wildlife rabies. We too often find it easy to overlook literature published outside the United States.

The *"Health and Management of Free-ranging Mammals"* is the proceedings from a conference held in Nancy, France in October 1991. Sponsored by the World Health Organization, the International Union for the Conservation of Nature and the Office of International des Epizooties, the meeting resulting in a proceedings that has 45 articles by 116 authors. The proceedings are printed in French, Spanish and English. The OIE publishes this quarterly scientific review on a variety of focused topics. The goal was to present current information to improve the management of wildlife populations. To do this, lessons and mistakes from the past are reviewed (e.g., introduction of myxomatosis for rabbit control). It makes some interesting reading! The proceedings are organized into three sections: current knowledge of various species and individual diseases, epidemiology of diseases (with reference to transmission, impact, models), and surveillance, control, prevention, and management of wild species.

The diseases that are included are wide ranging and very topical. From Lyme disease to Rabies to *Enchinococcus multilocularis* to *Morbilliviruses* in Pinnipeds and Cetaceans, emerging diseases are detailed in various areas around the world. More traditional topics such as sarcoptic mange (Swedish Arctic Foxes), tularemia (Cottontails), trypanosomiasis (Black Rhinoceros), dermatophilosis (camels) are also included. Papers detailing the rabies oral vaccine trials, tactics for control of wildlife rabies in Ontario (Canada), and disease risks associated with wildlife translocation projects are also included. In general, the papers discuss disease detection, monitoring, and how to avoid them—all areas of interest to wildlife rehabilitators. It is also interesting to read about the problems faced in such a wide variety of species in different habitats.

While these are not books that are about wildlife rehabilitation—they are books that a wildlife rehabilitator would find useful. If you don't want to purchase them, you might ask to see if your library could get them for you. *-Jan White, DVM-*

Upcoming Meetings

Association of Zoo Veterinary Technicians
October 5-9, 1993
St. Louis Zoological Gardens

For information contact: Barbara Jenness, (314) 781-0900) St. Louis Zoo, One Government Drive, St. Louis, MO 63110 or Virginia Crossett, (502) 459-2181) Louisville Zoo, P.O. Box 37250, Louisville, KY 40233.

Raptor Research Foundation
November 3-7
Marriot City Center,
Charlotte, North Carolina

For information contact the Carolina Raptor Center at P.O. Box 16443, Charlotte, NC 28297. You can call (704) 875-6521 for information.

Let IWRC know about your state or national meetings and we will let our members know!

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