

Lagomorphs of Minnesota with an Emphasis on the Rehabilitation of the Cottontail Rabbit

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Natural History and Anatomy

Lagomorphs are a prey species. They are abundant in population to serve as a food source for many other species higher on the food chain. Lagomorphs are ground dwelling animals taking cover in underbrush either in forests or on the edges of open fields. They have characteristically long ears and eyes set high on the sides of their head to allow for wide field vision. Hares generally are larger than rabbits with longer ears and hind feet. Hares' coats change to white or a whiter shade in winter whereas rabbits keep their brown coats year-round.

Lagomorphs are induced ovulators. The female become sexually receptive when an intact male is present. The eggs are dropped in response to copulation, versus cyclically. They can mate again immediately after giving birth.

Eastern Cottontail Rabbits weigh about 2-3 pounds as an adult. Gestation is about 28 days. The infants, called bunnies or kittens, are born completely dependent (altricial) without fur, and with both eyes and ears closed. They remain in the nest, a shallow depression lined with grass and fur, for 3-4 weeks. The mother rabbit comes only twice daily (approximately at dawn and dusk) to feed her young and stimulate/clean them but otherwise stays away from the nest to not attract predators to her nest's location.

Snowshoe Hares weigh about 3 pounds in adulthood. Gestation is about 35 days long. The infants are called leverets. They are precocial infants; able to hop around within 24 hours after birth. They are born with their eyes and ears open and fully furred. The leverets will gather once daily for a nursing from their mother. They are weaned at approximately 25-28 days; the last litter of the season may nurse longer, up to two months. They live in the northern half of Minnesota in dense forests and woody bogs.

White-tailed Jackrabbits are the largest Minnesota lagomorph weighing 5-10 pounds. Jackrabbit gestation is about 36-42 days long. The infants are also called leverets and are precocial. Weaning is complete by about 4 weeks of age. They live in the southern and western half of the state and prefer open grasslands for habitat.

Both rabbits and hares practice coprophagia, the ingestion of stools. This specialized behavior allows for the absorption of necessary nutrients that are difficult to obtain from a highly fibrous diet. Bacteria in the cecum help digest cellulose, and some nutrients are absorbed into the bloodstream directly from digestion in the cecum. Other nutrients that cannot be absorbed are passed through the anus as soft black pellets (cecotropes) which are ingested immediately. The second digestion of these nutrients allows all the necessary absorption to take place and waste material is then passed through the anus as hard round pellets which are not ingested.

Rehabilitation of the Eastern Cottontail Rabbit

Follow IWRC's Rabbit Hemorrhagic Disease Standard Operating Procedures to ensure safe housing and handling of all lagomorph species in light of spreading RHDV2 infections!

<https://theiwrc.org/wp-content/uploads/2020/05/RHDV2-SOP-20200515.pdf>

Public education is the key to assisting this species. Cottontails are usually the most common species rehabilitators get phone calls on, as well as numbers admitted to our care. Always try to keep infants with their mothers by assessing their condition and if they appear healthy, mark the nest with a recognizable pattern (X # or star) and check the next morning to see if the mother has returned to feed them. Taking pictures is very helpful to monitor for slight disturbances to stick pattern.

It is additionally helpful to have the public take pictures of rabbits' condition and abdomens. They can text us the images as it further guides us to determine if that rabbits need assistance.

When receiving the animal assess and document:

- Development/weight

	Newborn	3-6 days	7-10days	10-14 days
Weight in grams	<25-30	30-50	50-70	80+

- Hypothermia: Dry the animal; place them over a heating pad on low with a cloth towel as a barrier or place a hot water bottle wrapped in towel next to the animals. *Animal MUST be warm before feeding!
- Hydration: Determine by performing a skin tenting test (checking for loss of skin elasticity), or if animal has sunken eyes, dry mouth and gums, and/or is lethargic. To rehydrate, administer subcutaneous (under skin) warm, sterile Lactated Ringers, dilute 2.5% dextrose; and/or warm oral fluids (feed only if animal is warm). Oral fluids can be lactated ringers, pedialyte (or electrolyte replacement solution), 2.5% or 5% dextrose, or just water.
- Injury/illness: Contact veterinarian and/or mentor rehabilitator. Basic wound treatment applies to minor cuts or scrapes. Cat attack victims will need antibiotic treatment so consult veterinarian immediately.
- Parasites: Check thoroughly for fly eggs, maggots/bot fly larvae, fleas. Remove with flea comb, tweezers, flushing, and approved flea spray (make sure safe for infant animals). Maggots can be flushed off superficial

wounds. Consult veterinarian and/or mentor rehabilitator if maggot infestation or internal. Bot fly larvae should be removed carefully to ensure larva does not rupture; wound should be flushed with Normal Saline only in case the body wall has been compromised. Consult veterinarian.

- Stress levels: If animal starts struggling violently to get away, has quickened breathing/heartbeat, becomes limp/lethargic when previously active, or starts closing its eyes, place the animal in a quiet, dark enclosure for 20-30 minutes and resume examination/treatment when calmed.

Mark infants on the tip of the ear with colored nail polish to keep your records separate and accurate.

Housing

All rabbits should be kept in either plastic, glass or ½" hardware cloth (wire) enclosures. Always house rabbits with others only the same age and size. Infant rabbits with their eyes closed can be kept in small buckets with air holes and a lid or plastic critter carriers. A soft towel serves as a good liner for infants. Eyes opening/open orphans can be held in aquariums or plastic carriers. Good substrates are pee pads, towels, or other soft materials. Ensure substrate is in good condition as frayed edges/strings can be dangerous. Always provide a hiding house to help prevent overly stressed rabbits. This can be accomplished with a drape towel, a box for them to crawl into, or anything they can huddle inside. Outdoor housing should be completely protected from predators and in a safe place. Double walled cages or outdoor porches work well in areas with increased predator activity. I've been successfully using reinforced outdoor hutches for many years. I reinforce them with ½" hardware cloth and locking latches to make predator proof. All rabbit housing should be away from humans and pets in a private area.

A heat source needs to be provided through infancy until the rabbits are completely weaned. A heating pad set on low under half of the enclosure works the best. Make sure the heating pad does NOT have an automatic turn-off timer. Not all products will have that stated on the box; I recommend calling the manufacturer to ensure the product is safe for rehabilitation purposes. Clean cages once daily for younger orphans. Older orphans may need their cage cleaned twice daily as they will hop all over and soil their food sources. Using the same 'dirty' hiding box in the clean enclosure works well to keep the orphans less stressed though it should be cleaned or changed out if visibly soiled. Follow the guidelines set for caging in the *Minimum Standards for Wildlife Rehabilitation* provided by the NWRA/IRWC.

Feeding

Animals must be both warm and hydrated before feeding formula. There are a few different formulas/mixtures that can be used for milk replacement in Cottontails. These include Wombaroo, Fox Valley Day One 32/40 (supplement with Fox Valley Ultra Boost), goat's milk/formula, among others. I've been using Wombaroo and have been impressed with neonatal weight gain as compared to other formulas mentioned. A great resource for nutritional balance/formulas is EWild Again Formula Calculator (<http://www.ewildagain.org/index.html>). Formula should always be fed warmed, at about 100-104 degrees Fahrenheit. I use a mug warmer and a food thermometer to ensure appropriate temperature of formula during feeding. The feeding of formula should be gradually introduced in the following order:

	1 st feeding	2 nd feeding	3 rd & ongoing feedings
Formula Strength	25%	50%	Full strength 100%

Supplement formula with a probiotic to help prevent diarrhea and bloating. Ideally, cecotropes (soft, black, often grape-cluster appearing stool) from a healthy, parasite-free rabbit can be mixed into formula to provide nutrients and beneficial gastrointestinal bacteria. If you do not have access to cecotropes, other options include BeneBac, Fox Valley Day One LA200 or other probiotics designed for rabbits (or goats/horses, as they also digest via hind-gut fermentation). I have also have used plain organic kefir by adding a couple of drops to formula per feeding. Add in probiotics at each feeding (not to bulk stored formula). Unused formula should be kept refrigerated and discarded after 24 hours. Premix the formula at least 4 hours in advance to allow for complete dissolution of powder. This ensures uniform nutrient distribution, increases digestability, and helps prevent clogged feeding tubes with undissolved clumps of formula.

Calculate the amount of formula to be fed according to the animals' weight AFTER stimulation. Stomach capacity is 10% of the weight in grams and can be determined by the equation:

$$\text{Stomach capacity (mL)} = \text{weight (grams)} * 0.1$$

$$\text{Example: } 53 \text{ grams} * 0.1 = 5.3 \text{ mL stomach capacity}$$

Weigh animals with each feeding when young and keep records to ensure you're always feeding the correct amounts and track growth. Never exceed stomach capacity. Feed 2-3 times daily depending on the condition of

animal. If feeding more than twice daily you'll need to decrease the amount fed at each time (less than stomach capacity).

Syringe Feeding: Place animal in lateral recumbancy (belly down). Place tip of nipple in mouth and give one drop; feed calculated amount slowly monitoring for aspiration (formula in the lungs; sneezing/coughing, formula coming out the nose). Some infants will happily (and quickly) suckle on a nipple, others will struggle and get stressed. Be patient and try various syringe tips/techniques for each individual as they will determine what they prefer. You can use Miracle Nipple or a cat-tac nipple over a teat tube or cannula. Obviously the smaller the infant, a 1 mL syringe should be used. If an infant nurses well, a larger syringe can be helpful so reloading is not required as often, but you must be extra careful to not feed too quickly which increases risk for aspiration. A smaller syringe is always safer to reduce aspiration risk.

Tube Feeding: This is an advanced technique that has some advantages over syringe feeding. I have been almost exclusively tube feeding for the past 10+ years. It can be dangerous however if performed incorrectly. Have an experienced rehabilitator teach you manually how to do this. With the animal raised slightly vertical place a lubricated small feeding tube down the esophagus into the stomach. Return animal to natural lateral recumbancy with head slightly elevated and dispense calculated amount of formula slowly and then gently remove the tube. Tube size used should be 3.5 French for smaller eyes closed orphans. A larger 5 Fr. tube is useful for weaning rabbits as they will chew/puncture the smaller tube. However, use the smallest tube possible for the comfort/stress levels for rabbit. Tube feeding allows many more rabbits to be fed in the same time it would take to syringe feed just a few. The rabbit is guaranteed to get its full amount of formula, especially in the common event of a reluctant syringe feeder. *Incorrect placement of the tube can result in aspiration, puncturing of the esophagus, and death.* This technique is very helpful but please learn under the guidance of an experienced tube feeding rehabilitator.

Clean off each rabbit after feeding to prevent any formula build-up on fur. Clean all supplies in hot soapy water and appropriate disinfectant between feedings.

Infants need to be stimulated to urinate before each feeding. Gently rub the genital area with a cotton ball wet with warm water. Continue until cottonball is no longer soiled. You can also use Kleenex, gauze, soft towel, etc. You must stimulate cottontails until their eyes are completely open and developed and it is apparent that they are urinating on their own. This can be accomplished by palpating the bladder gently to assess for distention and

using white towels or pee pads as cage substrate to visually confirm independent urination.

Weaning should begin the day the rabbit starts to open its eyes. Always have dry timothy hay or orchard grass in their cage. I prefer orchard grass because it's softer than timothy hay, but both are nutritionally acceptable. Slowly introduce fresh greens (romaine lettuce, dandelion, wild plantain leaves, grass, clover, etc.). Wild Foods 4 Wildlife is a website that researches and lists safe and preferred naturally occurring foods for wild animals (www.wildfoods4wildlife.com). Always wash fresh greens before placing in cage. If foraging for naturally occurring plants, ensure the area being harvested is not treated with chemicals. Introduce one type of fresh green at a time, monitor for diarrhea. Decrease the amount of formula fed as the orphans start eating more solid food. Always have fresh water available. I also mix plain organic kefir with Oxbow Critical Care for Herbivores and place in shallow dish during weaning.

Common Complications

Diarrhea can lead to dehydration and death quickly in rabbits. If still on formula, back off concentration or stop. Instead, feed an electrolyte solution such as Fox Valley Electro-Stat or dilute Pedialyte and then slowly reintroduce formula. If it's an older rabbit, you can also syringe feed Oxbow Critical Care for Herbivores. Maintain hydration with subcutaneous fluids as needed. Treatment options for diarrhea includes

- Wet Tail Drops (neomycin sulfate 20 mg/mL)
 - Initial dose = 0.4 mL orally then
 - 0.2 mL BID orally x5 days (for weaning size rabbit)

OR

- Kaolin Pectin (90 grams / fluid oz)
 - 1-2 mL per kg

If possible, a diagnostic fecal should be obtained via your veterinarian. This will enable you to accurately treat the possibility of an intestinal parasite infestation. Other prescription medications may be helpful in treating enteritis caused by an overgrowth of bad bacteria.

Coccidiosis has been identified as a significant cause of GI disease and associated mortality in young rabbits in rehabilitative care (Gabriele Paul, NWRA symposium 2021). Through Paul's research, the Colorado Wild Rabbit Foundation implemented a prophylactic protocol:

- Toltrazuril 25 mg/kg PO, SID, x 2d then 5d off
 - Starting at intake or when eyes open, repeat until release

Gastrointestinal stasis (often called 'bloat') is a potentially deadly condition that rehabilitators may encounter in rabbits. This is a very painful condition where their GI track slows or stops down resulting in abdominal bloating, decreased absorption of nutrients, dehydration, constipation and/or diarrhea. It frequently leads to death if not identified and aggressively treated early. Contact your veterinarian and/or mentor rehabilitator immediately. Treatment includes, maintaining hydration through subcutaneous fluids, gentle abdominal massage, medication administration (under veterinarian guidance; GI motility aid, pain meds, gas relief), and feeding Oxbow Critical Care for Herbivores in small amounts. Early identification of GI stasis is crucial. Early symptoms include a disproportionate weight gain from previous feedings, slightly puffed/hunched appearance, and being less active. By the time the rabbit exhibits diarrhea, a distended abdomen, and lethargy, the likelihood of successful treatment is significantly reduced. Monitoring your patients closely and assessing weight trends is critical to catching GI stasis early.

Release

Releasing cottontail orphans is an art. It depends heavily on behavior versus numerical data (weight or age). If you hold onto a rabbit too long, they can get stressed and die (captivity/capture myopathy). Typically, the age to release is between four to eight weeks with a healthy body condition. Groups of rabbits mature quickly and typically are released at earlier age than singletons. All orphans should be acclimated to outdoor weather conditions. Solid foods should be their only diet for a minimum of one week prior to release. Behavior to watch for includes boxing (jumping at your hand), trying to escape, digging, and if there is any aggression between juveniles, it is time to release your rabbits. Release sites should be as safe as possible, an area away from predators (including cats), that has plenty of food sources and hiding areas. You will want to have many sites you can use. Release them into a brushy area adjacent to grassy areas with plenty of hiding places. Since rabbits are crepuscular it is best to release them near dawn or dusk. I prefer dawn to provide them more time to find appropriate hiding places before nightfall.

Supply, Formula & Helpful Links:

www.ewildagain.org/index.html

www.wildfoods4wildlife

www.foxvalleynutrition.com

www.squirrelsandmore.com

www.oxbowanimalhealth.com/blog/the-inside-scoop-on-rabbit-poops

<https://www.oxbowanimalhealth.com/vet-connect/>

Free online databases:

www.WRMD.org

www.wildlifecenter.org/wild-one

As rehabilitators we are most successful when we collaborate with others. Network and maintain relationships with other rehabilitators, including organizations and facilities. Share information and struggles. Don't be afraid to ask questions or try new techniques. Attend trainings locally and nationally. The sharing of information will improve the care we provide to our wild patients.
