Wildlife Nutrition

A Publication of Canada's Accredited Zoos and Aquariums
Nutrition Advisory and Research Group (CAZA-NARG)

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Thank you!

This edition of Wildlife Nutrition is the first year anniversary of the newsletter. I appreciate the feedback and response from subscribers this past year.

One result of feedback from subscribers is a change in the newsletter format. The newsletter can now be printed since this request was one of the most frequent I received.

Every subscriber attends an institution or organization entering into the busiest time of the year. Best wishes during this season!!

Deb McWilliams

Photo courtesy: the Canadian Wildlife Federation

Photo courtesy: Nature Canada

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In This Issue . . .

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Considerations for Hand-rearing Calves of Ruminant Species

This is the time of year when some calves of ruminant species may need hand-rearing for several reasons including orphans coming into the care of wildlife institutions and organizations. I am often asked for the best way to meet the nutritional needs of a calf when they are hand-reared. Unfortunately, given the diversity of species, ages and health states of calves that need hand-rearing, we cannot speak in terms of any one "best" methodology. However, there are some general guidelines we can use when hand-rearing calves.

The Wild Feeding Ecology of the Species

The gastrointestinal tract (GIT) function and nutrient requirements of a species has been determined by the evolutionary development within an environment and the result is the wild feeding ecology. In captivity, our goal – and challenge - is to support healthy GIT function and meet the nutrient requirements of the calf based on the wild feeding ecology of the species. We often have to accomplish this goal without the diversity of foods available to animals in the wild.

The calves of ruminant animals are considered to be "pre-ruminant". However, research shows that 14 day old calves have (should have) all the major types of gut microorganisms as adult ruminant animals (Li et al, 2012). Therefore, from the beginning of captive hand-rearing, it is important to provide a calf with the appropriate formula and also provide forage on an ad lib basis to support gut microorganisms. The appropriate milk formula and forage may vary depending on the species.

Feeding Schedule. In general, most neonatal calves of wild ruminant species have a suckling schedule that consists of frequent bouts of suckling, but each bout is relatively brief. Older calves will not suckle as often, but they will suckle longer than neonatal calves.

It is very challenging hand-feeding neonatal calves because the frequent suckling schedule may not be possible due to staff and/or financial limits. However, when possible, neonatal calves should be provided with as many feeding opportunities as time and staff allow.

Milk Quality. Lactating females produce the highest levels (amount) of milk in the first two to three weeks after calving with a gradual decline in milk production as the calf ages. This milk, in general, will have the higher percentage of solids just after the birth of the calf and the percentage of solids will gradually decrease as the calf ages. In captivity, this may require mixing powdered milk formulas at a higher ratio of powder (solids) at first and then gradually decrease the powder (solid) ratio.

Forage. In the wild, most calves begin to forage within two weeks of birth by eating those foods introduced by the cow. Up to 30 days of age, calves will forage about 2% of the day, but by 60 days of age the calves forage as much as adult animals (Reese & Robbins, 1994). Initially, calves will preferentially eat the higher protein, more digestible foods (e.g., the soft ends of hay, new leaves, shoots, etc). As the calves' rumen microbial population and rumen microvilli develop, the calves can obtain nutrients from foods lower in protein and higher in fiber and they will gradually change their diet choices. In captivity, the best forage is browse from plant species normally eaten by the species of the calf. Browse must be mostly green (leafy) and branches should not be greater than ¼ inch in diameter. If natural browse – or enough browse – is not available, then the appropriate type of hay can be used. Grazing species should be fed grass hay and browsing species should be fed alfalfa hay (or other legume hay if available). Hay should be high quality, leafy and should be chopped for very young calves.

Calf Background

Historical information assists in diet formulation for calves based on age and health history. If a calf is born in captivity and needs to be hand-raised, we usually have historical information about that animal including birth conditions, age and diet history. However, we usually lack historical information on any orphaned or abandoned calf that comes into care from the wild. For these calves, although appropriate diet formulation can be a challenge, we can make some assumptions:

1. **A History of Poor Nutrition**. Most calves coming into care will have experienced a period of malnutrition where they did not get enough food or were without food. It is important to avoid over-feeding to compensate for weight loss or to satisfy calf hunger. In general, provide frequent feedings of smaller amounts of food and do not allow the calf to gorge on any feed.

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1. **Metabolic Bone Disease**. A history of malnutrition in calves often results in metabolic bone disease (MBD). One study reports at least a 26% incidence of osteoporosis in moose calves and juveniles due to malnutrition (Ytrehus B et al., 1999). Calves received into care should be assessed for MBD or should be suspected as having MBD. The diagnosis, or possible diagnosis of MBD, means the animal must be handled with care to avoid fractures. Housing areas should be padded when possible and efforts made to not startle the calves to prevent running into walls or fences. Mineral and vitamin supplements should not be given. Supplements will not hasten the recovery process, but they do often result in vitamin and/or mineral toxicosis especially with vitamins A, D and E and the minerals calcium, phosphorus, cobalt, copper and iron.

A Captive Dietary Regime

The best dietary regimen will be the one based on the wild feeding ecology and the biology of the calf species. However, there are some general guidelines that are appropriate to most calf species.

1. **Low Sugar and low starch.** Diets must be low in sugar and starch. This means that pellets high in sugar and starch, fruits, vegetables and bread products should not be fed to calves. A high sugar, high starch diet in addition to a lack of forage (type and amount) typically results in nutrient deficiencies and gastrointestinal pathology such as rumenitis. Such a diet cannot support and establish the appropriate gut bacterial colonies needed to digest food and produce important nutrients such as volatile fatty acids.
2. **Dietary Fibre**. Calves need increasing amounts of dietary fibre to establish and support the appropriate gut bacterial colonies. In the wild, calves begin to ingest forage within the first two weeks of life by eating the same foods ingested by adults. As the calf grows, there is a gradual decrease in the amount of suckling and a gradual increase in the amount of solid foods ingested.
3. **Nursing Equipment**. Bottles used for formula should be those used for domesticated calves and cleaned thoroughly between feedings. The hole in the teat may have to be adjusted for some species. Bottles and plastics not safe for use with foods and not suitable for multiple uses should not be used because these materials can be a source of toxins.
4. **Monitor Feed Intake.** All foods whether formula, forage or commercial feeds should be measured and weighed back to monitor feed intake. Supplement and medications should also be recorded on feed intake sheets. Data collection should also include the date and times of feedings and staff identification if several staff members feed the calf.
5. **Weigh Regularly.** Regular weighing of the calf provides information of how the calf is using the diet provided. When possible, compare weight and growth data to known growth data of the species.
6. **Monitor Feces.** A system of fecal quality giving a quantitative assessment of feces should be provided to staff. Staff should assess and record the fecal quality on the feed intake sheet noting date and time of assessment. This system works best for fresh feces.

(*Photo Courtesy: San Diego Zoo*)

Problem:
Corneal Lipidosis in Amphibians

Corneal lipidosis commonly refers to a condition when cholesterol and phospholipid accumulate in the cornea, the transparent covering of the iris and pupil. The disease first appears as an opaque or cloudy appearance to both eyes that limits vision and can progress to blindness. Amphibians hunt by sight, therefore reduced vision and blindness can lead to reduced food intake and death.

There are three typical causes for corneal lipidosis including 1) corneal dystrophy (inherited condition) 2) corneal degeneration caused by age, irritants and/or inflammations and, 3) lipid keratopathy caused by high blood cholesterol levels. Lipid keratopathy may be linked to diet, therefore let us look at possible diet factors in the development of lipid keratopathy in amphibians.

Lipid keratopathy develops when an animal has high serum or plasma levels of cholesterol. These high levels of cholesterol are most often related to diets high in saturated fats and cholesterol and/or dietary sources of fat inappropriate for a species. Research is lacking on lipid keratopathy and most of the existing research is on pet animals especially dogs, cats, rabbits and guinea pigs. However, lipid keratopathy is often reported in captive amphibian species.

First, a brief review of amphibian nutrition. Most amphibians – as adults – are opportunistic predators, but all are carnivores that hunt prey relative to their body size. For example, smaller amphibian species will hunt insects and other invertebrates and larger amphibian species will hunt larger prey including rodents and small birds.

Although there is a lack of research on lipid keratopathy in amphibians, the condition is correlated with captive diets high in saturated fats usually in the form of inappropriate prey. For example, ground meat diets and diets consisting mostly of day old chick carcasses or overweight rodents are very high in saturated fats and could pre-dispose an amphibian to developing lipid keratopathy.

When formulating diets for captive amphibians, one must respect the evolutionary dietary niche that has formed the animal's physiology and gastrointestinal tract. Captive diets based on the wild diet of a species are the most appropriate diet.

Photo Courtesy: Edmonton Reptiles

Problems Wanted!!

Each issue of "Wildlife Nutrition" will present and discuss a specific dietary challenge submitted by readers. Any aspect of the nutrition of captive wildlife will be considered for publication. The dietary challenge may be a question, situation or nutritional pathology. Questions re: body condition must be accompanied with a photo. The identity of the submitting individual and/or their organization will be confidential. Please submit to:

Wildlife Nutrition
info@caza-narg.ca

Nutrition for Captive Seabirds: Charadriiformes

Charadriiformes include alcids, gulls and shorebirds whose diet is piscivorous (fish-based) and/or microfaunivorous (aquatic invertebrates). Alcids, gulls and shorebirds are opportunistic predators in the wild with a gastrointestinal (GIT) flexibility that responds to the diet although there is variation in digestive efficiency between and among species and diets. The caeca of Charadriiformes is also variable - from vestigial to large - and species eating primarily diets with low ratios of flesh to shell (e.g. microfaunivores) would have the largest caeca.

In captivity, we have various limitations in provisioning diets for these birds and diets are often limited to a few species of prey fish. For example, the variety of fish fed on by wild species is not available when feeding captives. Current recommendations include feeding at least three different species (both fin fish and aquatic invertebrates for complementary nutrients) and supplement with thiamine and vitamin E. Vitamin E is often prescribed because we know wild diets contain high levels and vitamin E is not stable during processing and storage. Supplementing thiamin (B1) is a necessity when fish (clams, herring, smelt and mackerel) containing thiaminase, an enzyme that degrades thiamine, are fed. In addition, thiamine is easily degraded during handling and storage by heat and oxygen

In general, there is a lack of research on Charadriiformes nutrition including seasonal dietary needs (e.g. moult) and life-stage nutrition (e.g. breeding or neonatal). Life-stage nutrition of captive Charadriiformes is of particular importance as zoological institutions continue to expand their participation in conservation efforts. We cannot present a comprehensive discussion on nutrition for Charadriiformes in this article, but let us look at some information on dietary fat, carotenoids, minerals and, vitamins.

Dietary Fat. Avians use dietary fat as energy and have evolved on diets high in unsaturated fats. Dietary fat averages a 90% digestibility for Charadriiformes. Yolk lipids provide more than 90% of the energy needed by chicks for hatching and growth.

Lipids in fish prey will vary depending on the environment and life stage of the fish. For example, oily fish (cold water, marine fish) store fat in muscle, but the fat content varies from 1% (after spawning) to 20% (before spawning). Prey fish from freshwater or warmer bodies of water are called “nonoily fish” because fat is stored in their liver. Captive piscivores fed fish carcasses prepared for human consumption lack viscera (including the liver) and it might result in a captive diet deficient in fat and fatty acids.

The function of the uropygial gland (preen gland) in Charadriiformes is affected by dietary fats. The preen gland function is lipogenesis and, in Charadriiformes, an average of 600 milligram (mg) of oily sebum is produced daily by the gland. The sebum is made of monoester and diester waxes consisting of fatty acids, mucins, lipids and glycerides. Birds smear the sebum on feathers and podotheca (scaly integument on the feet and legs) to maintain feather and skin pliability and waterproof the feathers. Sebum also has a pheromonal role, protects against ultraviolet (UV) light and, it has antibacterial and anti-mycotic roles. The composition of sebum produced by preen glands does vary among avian species which is expected if it has a role in pheromone production. The chemical composition of sebum is linked to diet, but not directly. For example, not all fatty acids found in the sebum may be found in the diet, but the diet will affect the ability of the preen gland to produce the appropriate type and amount of sebum. Sebum also varies seasonally and this makes sense based on the pheromone role. Diesters, for example, appear in the sebum of wild and captive birds only during breeding and incubation.

Fatty Acids. In addition general dietary fat requirements, there must be consideration for the types of fatty acids inherent in dietary fat requirements. Fish prey varies in fatty acid composition depending on environment. For example, freshwater fish has twice as much capric acid (C10:0) and stearic (C18:0) fatty acids than cold water (marine) fish, but less than half the quantity of arachidonic (C20:4) and only one-seventh the quantity of behenic acid (C22:0) found in marine fish. This implies that captive Charadriiformes have different requirements for dietary fatty acid composition depending on their evolutionary environments. Meaning: freshwater avian piscivores may need freshwater prey and marine piscivores may need marine prey.

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Carotenoids. Dietary carotenoids are a source of feather pigmentation for Charadriiformes via absorption of carotenoids by fat globules in the contour feathers. Dietary carotenoids are also precursors of vitamin A. In addition to pigmentation and vitamin A synthesis, carotenoids act as an antioxidant and have a protective role from UV light.

Approximately 2% dietary fat is needed by avians to facilitate the absorption of fat-soluble vitamins and carotenoids. Charadriiforme species in the wild obtain their dietary carotenoids from their prey, but captives may not get sufficient dietary carotenoids if they are fed whole fish without viscera; if they are fed farmed fish that have not been supplemented with carotenoids; and, if the captives are not fed crustaceans. There are several commercial products that could provide dietary carotenoids to captive Charadriiformes (e.g. astaxanthin, canthaxanthin and crustacean meal). Handling and storage of carotenoids is important because the bioactivity of these sources are easily degraded by light, heat, oxygen, enzymes and inappropriate pH environments.

Minerals. We lack research on the dietary mineral needs of Charadriiformes. Currently, identifiable mineral deficiencies and excesses for captive Charadriiforme species are related to dietary calcium deficits. Despite whole-fish diets (some lacking viscera), calcium deficits usually result because of a high dietary phosphorous level and/or dietary deficiencies or excesses of vitamin D_3 caused by inappropriate dietary supplementation.

Vitamins. Whole fish can be an excellent source of dietary vitamins including vitamin D3, vitamin A, riboflavin, niacin, pantothenic acid, vitamin B6, vitamin B12 and choline. However, most of these vitamins are found in viscera. If captive Charadriiformes are fed fish prepared for human consumption, they are probably eating carcasses with the viscera removed and may develop deficiencies. Supplementation is always an option when deficiencies are identified. However, we lack information on the vitamin requirements of most Charadriiforme species. Toxicities most likely to develop from inappropriate supplementation are from the fat-soluble vitamins such as vitamins A and D.

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Wildlife Nutrition
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CAZA Wildlife Nutrition Ruminant Browser: **Our browser pellet has been formulated based on the wild feeding ecology of browsing ruminant species*. It is a low-sugar, low-starch pellet that offers the appropriate types and ratios of fibre recommended for browsing ruminant species. This product must be fed with forage (hay or browse).**

*Antelope species, caribou (reindeer), deer, elk, giraffe, goat species (most, including ibex and mountain goats), moose, mountain sheep, musk oxen

CAZA Rodent Herbivore with Vitamin C: **Our Rodent herbivore with vitamin C is formulated based on the wild feeding ecology of herbivorous rodent species including beaver, capybara, porcupine and rock hyrax. It is a low-sugar, low-starch pellet that offers the appropriate types and ratios of fibre recommended for browsing ruminant species. This product must be fed with forage (hay or browse).**

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