

Mealworms - Separating Truth from Misguided Information

Dan Gleason, 2021 (See biographical information at the end of this article)

Summary: Recent social media and Facebook posts regarding the safety of feeding mealworms to wild birds have caused considerable concern amongst people who feed birds in their yards, among wild bird rehabilitators and amongst people who own stores catering to the backyard naturalists who love to watch birds. One Facebook post in particular was sent out and shared repeatedly which threatened that baby birds will die if fed mealworms, particularly freeze-dried mealworms.

This paper examines the claims in the initial social media and Facebook posts to determine which claims are false and illegitimate, and which have a kernel of truth, and how the original posts allow the reader to come to misleading conclusions. The author of this paper follows the scientific facts to determine the validity or lack thereof of the original social media author's claims.

Mealworms are not really “worms” but are the larval form of the mealworm beetle, *Tenebrio molitor*, the scientific name for these insects. They have a short breeding cycle and lifespan and can easily be raised in large numbers, making them an easy animal to be grown and used for scientific research and as food for insect-eating animals. In this context, we are looking at mealworms as a food that can be easily provided to wild birds.

Like many topics, much information can be found on websites and blogs about mealworms. Unfortunately, some of this information is provided by well-meaning, but badly-misinformed people who publish information on their sites that is completely wrong. It is my intent with this article to provide you with the most accurate information I can about mealworms and directly refute some of this incorrect and misleading information.

Before I address some disinformation I have read, let me first state my view about mealworms. They are a good food source that you can supply to attract wild birds. Live mealworms are far better than dried mealworms in a number of ways but both work well. Baby birds would be better off with live mealworms which are easier for the young birds' digestive systems to handle. Mealworms are not high in nutritional value but do provide a good supplement, since wild, natural insects are a superior source of nutrition. Mealworms are raised in very large quantities: one Chinese insect farm ships out over 50 tons of live mealworms per month and over 200,000 tons of dried mealworms per year. Most of these are for the human, pet and other food markets, and edible insects for human consumption are becoming more popular in Asia and parts of Europe. Because mealworms are so easy to raise and can be grown in such vast quantity, they are often not fed a highly nutritional diet, and wheat or oat bran is the usual substrate used for growing them. There is research being done at Stanford University regarding feeding them polystyrene and early research indications were that the mealworms fed on it were still full of nutrition; the research was initially begun as a way to recycle polystyrene. Because of mealworms' low nutritional content, most rehabbers moisten and coat the mealworms with a nutritional powder formulated to meet the needs of young birds. But please be assured that providing mealworms to birds does them no harm. They will love the treat and you will have the pleasure of attracting birds to your yard.

Some of the information that follows may at first, not seem directly related to the issue of feeding mealworms. But bear with me. There were/are many factual inaccuracies in some of the blogs and websites

that promote a point of view that feeding mealworms is dangerous or fatal to some birds, and many of the inaccuracies involve a misunderstanding of bird biology. I want to correct some of the misconceptions, and in so doing, I hope to give you a better understanding about why some of the things being said don't make sense. Getting a better understanding of some basic bird biology will help you to understand why some statements are wrong and how this relates to feeding mealworms.

One particular article has had widespread distribution and unfortunately, contains many errors. It claims that mealworms, particularly dried mealworms, are deadly for birds. The claim is that the dried mealworms become compacted in the stomach and cause a bird's death through constipation and dehydration. First, let me reassure you that this does not happen to wild birds. I don't know what the author has seen but they are misunderstanding what they think they are seeing. A compaction problem is not likely to occur in wild birds. Expert, well-respected wildlife rehabilitators from all over the country say they have not seen this. Although they have never seen this in their years of work they can imagine conditions in which it might occur, but ONLY in rehab or hand-raised birds, never in wild birds. If it occurs in rehab birds the birds would need to be suffering from other conditions first, such as dehydration and emaciation, and these would not be found in otherwise healthy birds. Additionally, it would be an irresponsible rehabber who fed only dried mealworms. If such compaction of mealworm exoskeletons were a problem, then you would have to conclude that many of the insects birds feed on in the wild could also be a problem. Many species of insect prey have harder, more indigestible parts, such as the carapaces of many adult beetles or the wings of many insects. Birds have eaten such insects for millions of years and not died of "compaction."

I think that what is really being seen in the case referenced (in the now-deleted article) is normal but misinterpreted. To understand this, let's first examine some basic bird anatomy. The stomach of a bird has two parts: the forward portion of the stomach is called the *proventriculus*, and is where enzymatic digestion occurs. This part of the stomach is very, very acidic with a pH often below 2.0, and its structure is very well-developed in birds of prey, fish-eating birds and insect-eating birds including many songbirds. The rear portion of the stomach is the *ventriculus*, or more commonly referred to as the gizzard, and is the muscular portion of the stomach. Contractions of the strong muscular wall of the gizzard are very efficient at breaking up seeds and other hard material not dissolved by the proventriculus, and seed-eating birds' gizzard is very well-developed.

Both parts of the stomach are well-developed and fully functional in many songbirds as they feed on both insects and seeds: food passes from the proventriculus to the gizzard which macerates seeds, etc. before passing this predigested food on to the intestine. Any indigestible material is retained by the gizzard which then compacts it into a pellet. Eventually, this pellet is pushed forward and returned to the proventriculus. It may be held here for up to several hours in the case of owls and other birds of prey, or ejected much more quickly in songbirds. Because the pellet blocks the digestive path, it must be forcibly regurgitated before another meal can be eaten, whether that is in hours or minutes. What the article refers to as "compaction" and that the author says is deadly for the bird is simply this undigested material being formed into a pellet by the gizzard or being held in the proventriculus before regurgitation. This is normal and not the sign of a bird in distress or being killed. All birds that cast pellets do this!

Just as an aside here, owls are probably the birds most people are familiar with as casting pellets. That's because owl pellets contain feathers or fur and bone, often with the complete, although detached skeleton of a small mammal. This happens because owls do not have a low pH in the stomach; a very low pH (very acidic)

in other birds of prey dissolves the bones of prey species. Owls do not have the low pH so no bone is dissolved. The pellets of most birds that form them are not so tightly compacted or as large as in owls. Cormorants cough up pellets that are mostly fish scales, these quickly fall apart and usually not enough remains to be found by curious humans. Songbirds cast pellets often made up of insect exoskeleton parts and insect wings.



Photo: Loggerhead Shrike casting a pellet of the inedible portions of its recent meal.
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The article in question also included a photo purported to be fecal matter from a sparrow that had this supposed compaction problem. In that photo, one could clearly see fibrous matter in the sample. But this photo is NOT of fecal matter! These are pellets of indigestible matter that the bird has regurgitated. I am not alone in this assessment: every bird rehabber and avian veterinarian who has seen this photo has identified it as a cast up pellet and not fecal matter.

Because dehydrated mealworms are dry, an assumption is being made that dehydrated mealworms must be rehydrated before being consumed and that many birds don't drink water. This idea simply is NOT true. Any rehydration necessary will happen internally and the birds will not become dehydrated in the process.

Thirst is natural and if a bird, any bird, is thirsty it will drink from an available source. Dry seeds are eaten and ground by the gizzard without a problem so there is no reason to believe that some dried mealworms cannot be equally well-handled by the digestive system. The article also states that only some birds drink water but others, specifically chickadees, don't drink and are thus in danger of becoming dehydrated. It's not stated why there is a belief that chickadees don't drink and this makes no sense.

Chickadees most certainly do drink water, and frequently. It may be surprising to some people that winter is a time when dehydration can occur. Chickadees regularly come to open water to drink during the winter and in frozen conditions, they drink from icicles and eat snow for a source of water. Hot weather can also bring the risk of dehydration and chickadees seek open water at that time as well. **Eating dried mealworms does not cause dehydration in birds and they are perfectly capable of getting water if they need it.**

It has been stated that dried mealworms are full of fat and therefore, birds will gorge themselves on them. The assumption here seems to be that if we humans like fatty foods, then birds must like them as well. It is NOT a safe assumption that human feelings and preferences are also those of birds or any other animal. An attraction to fatty foods was helpful in our evolutionary history: more calories are produced by using fat as a fuel than by the use of proteins or carbohydrates. By being naturally attracted to fatty foods, we could store foods that were energy-rich which helped us survive hard times. Some birds are attracted to fatty foods, but certainly not all birds and not at all times of year.

All birds store fat, although not exactly in the way we do. In birds, fat is stored as a subcutaneous layer and some fat is stored within the muscles. Fat is rarely stored around the heart as is the case in mammals...the exception is that some birds in captivity, can become obese and very unhealthy, with fat that is stored around the heart. But, for wild birds, fat is THE fuel for migration. Many birds will dramatically increase their fat storage prior to migration. In some shorebirds, as much as 60% of the body's mass is fat as they prepare for migration. Rufous and Ruby-throated Hummingbirds double their weight in fat prior to migration, and fat is the fuel a hummingbird uses to survive the night. But fatty foods are not sought out by all birds: a hummingbird increases its intake of sugar in the hours before dusk. This sugar is converted to fat by the liver and the fat is slowly burned to survive the night while in torpor. Other birds also seek carbohydrate-rich foods, not fats directly.

An attraction to fats is certainly not a factor in a bird's consumption of mealworms. Mealworms do contain fat but they are not "full of fat," as stated in the article. The nutritional composition of a mealworm by one analysis is as follows:

Live mealworms: 62% moisture, 13% lipid (fat), 20% protein, 1.5% ash, and 3.1% carbohydrate.

Dried mealworms (moisture removed, so all other values will be higher): 5% moisture, 28% lipid, 53% protein, 4.1% ash, and 8.5% carbohydrate.

Despite appearing to be higher in fat, dried mealworms' fat percentage changes once moisture is restored, either within or before eaten by a bird.



Photos: Left: Live mealworms, the larval form; right: a Darkling Beetle, the mealworm adult

The article in question states that you should never feed mealworms to breeding birds because it will kill the babies and the parents won't know when to stop feeding them. **Mealworms will NOT kill the babies.** Adults feed a wide variety of wild food to their babies and they will certainly never overfeed them. It's a never-ending task to take care of a brood of young birds. A pair of House Wrens was counted making over 500 trips to the nest with food in just one day of feeding. At that rate, it's hard to overfeed!

There is the claim that fruit-eating birds will not get proper nutrition if they are fed mealworms instead of fruit, so birds like American Robins and Cedar Waxwings should only get very small quantities of mealworms.

Any bird that is strictly a fruit-eater will have no interest in mealworms so there is no worry about them. American Robins, however, are not strictly fruit eaters. Nearly 50% of a robin's diet is animal matter, mostly insects, earthworms and other invertebrates. They have even been reported eating such things as small snakes, lizards, and frogs, although these may be very unusual. What they eat depends on the time of year, habitat and what part of the country they are found in. Fruits are a predominant food during the winter and insects and earthworms are more heavily consumed in spring and summer. Cedar Waxwings eat almost exclusively fruits during the winter. If presented with mealworms, they would have little interest in eating them then. During spring and summer, insects do play an important role in a waxwing's diet, however, and some mealworms may be taken by them at that time. However, waxwings are much more interested in flying insects. In general, all insects are not equally attractive to all insect-eating birds.

Unfortunately, this article continues with some very bad fallacies that I really must correct, as these statements show a complete lack of understanding about birds. The statement is made that feeding a lot of mealworms during the breeding season will "trick" the birds into having a second or third brood when the female is already "depleted." It is unclear what is meant by depleted. It goes on to say that when the female is pregnant, the growing baby is hard on the mother's body. Further stating that much of the nutrition for the chick comes out of the mother's body. Then it follows with the incredible statement that birds having a third brood will not have to endurance to get to their wintering grounds.

There are so many misconceptions and falsehoods in this that it is hard to know where to start!

Let me begin with some very basic avian biology severely lacking in these statements. First, wild birds will always feed on the variety of foods they need. Mealworms may be consumed but never exclusively. The birds will get a balanced diet, so the risk of mealworms being less nutritious is of no concern.

“Birds fed a lot of mealworms may be tricked into having a second or third brood when the females body is already too depleted.” This is sheer fantasy with absolutely no basis in fact! During the breeding season and just after, there are still plenty of insects in the environment that the birds feed upon. Why don't these insects “trick” the female into having too many broods? Why would mealworms cause this when the natural population of insects doesn't? The reason is that the birds cannot be tricked into having more broods! Many birds are single-brooded, like most hummingbirds and most neotropical migrants. Many non-migratory small birds are double-brooded and a few occasionally have a third brood. There is nothing you can do to change these behaviors. Unusual and severely limiting conditions may sometimes cause a delay or nest failure, but feeding mealworms can never cause birds to have more broods than they are biologically set for. Period.

The author states that having a third brood means that the birds cannot reach their wintering grounds. More nonsense. Birds that do have third broods are non-migratory species. They have the time to start early, before neotropical migrants arrive. The arriving migratory species will not have a third brood. Most of them only have time to arrive, find territories, establish pair-bonds, breed and raise a single brood of young. There is no time to raise a second brood before returning to their non-breeding habitats and no attempt is ever made to do so. At the time they are finishing their first brood, there are still plenty of insects in the environment and this abundance of insects does not trigger multiple broods or bring about poor conditions for migration. Prior to migration, these birds' hormones have changed and their physiology is turning to storing the fat that will be the fuel for migration. The whole physiology of the body is shifting and the hormones that induce breeding behaviors and conditions have diminished and are no longer playing a significant role in the bird's activities. No amount of mealworms, or natural insects, can change this.

Such changes are not induced by food, in most cases, but by changes in day-length. A few species, like Pine Siskins, are triggered to breed by an abundance of food and may breed in many months of the year. But the trigger is the abundance of **natural** foods and in sufficient quantity to sustain entire populations for several months. Mealworms put out in your backyard could never provide enough food to trigger this behavior in such species. The birds exhibiting this kind of behavior are feeding on an abundance of conifer seeds, NOT mealworms.

The author states that, “...being pregnant and growing babies is hard work on a mother's body. Much of the nutrition for a growing baby comes out of a mother's body.” Females that birth live young, placental mammals, some fish and some reptiles, get pregnant. Birds do NOT get pregnant. No birds give birth to live baby birds, they ALL lay external eggs. Does the author not understand about eggs?!? The growing baby chick does not grow in the mother's body nor take any form of nourishment from the mother while it grows and develops in the egg.

Prior to laying an egg, the female's body produces yolk material which will become associated with the egg cell (the gamete, not the hard-shelled structure we refer to as an egg) before it is released from the ovary. If fertilized, over the next 24 hours, it will pass along the oviduct where albumen and other membranes are added and finally, a shell is produced around it just before it is laid. From that point on, all growth is within the

egg and all nourishment comes from the yolk. The female has nothing to do with the growing chick other than to provide the warmth and protection needed for the growing chick to survive until hatching. Her body provides no nourishment, unlike a placental mammal. Calcium is taken from the mother's bones (primarily) but not for the growing chick. Calcium from the female's body is used to produce the egg shell. The female will replenish her supply of calcium through her diet. Additionally, after the chick(s) has hatched, the mother may eat some of the fecal droppings of the chicks. For the first few days after hatching, the chicks do not process all of the food well, so eating the droppings of her young can provide the female with some extra nutrition including some calcium. The growing chick takes nothing from the mother while it is the egg.

The article then states that our yards don't provide sufficient insects to provide for many breeding birds. Many yards **do** have the necessary foods to sustain more than one nesting pair, even small yards. But birds establish territories and effectively prevent others from entering that territory, at least within a given species. But different species may breed quite successfully in the same yard. It would not be at all unusual for a pair of Black-capped Chickadees, a pair of Song Sparrows, a pair of California Scrub-Jays and a pair of Bushtits to all nest successfully in a small yard, assuming the right conditions of *habitat* exists for each of them. Foraging competition would be minimal as each of these species forages differently and seeks different insects (and many seeds in the case of the Song Sparrow). If yards lack the food resources, why do so many species successfully raise young each year? In a suburban setting, one yard is not likely to be more productive than most neighboring yards. If our yards are so poor, where are the birds finding food?

The ridiculous claim is made that luring birds into your yard with mealworms will cause their young to die from being fed mealworms and not getting the other insects they need. But this will not happen. Birds cannot be "tricked" into an area by mealworms. Many different habitat and food characteristics are essential for birds to come into an area and start breeding. Providing mealworms will NOT override these other important factors.

Not all birds eat seeds. There are still many insectivores found throughout the winter and many insects and spiders persist through the winter. Foraging techniques differ for finding them in the winter but that food resource is still there. Consider Anna's Hummingbirds: they are now common in many parts of the Pacific Northwest at all times of the year. They will consume the nectar you provide in your feeders and they find other sources of sugar in nature, but sugar nectar cannot be their only food source, as they also require protein. Experimentally, hummingbirds can only live 10-12 days if their only food is nectar. Insects and spiders are essential as a protein source and there are plenty around for the hummingbirds to find and exist on, even if you can't see them. Big humans really aren't very good at noticing tiny insects on surfaces of plants!

(In our store bird walks, we will sometimes watch as a flock of Bushtits or other species flits through trees nearby, pausing to glean insects from the undersides of human-eye-level leaves. We will approach after they leave and our goal is to find as many teeny food items for a bird as we can.)

There is one potential danger that very recently become known about the consumption of mealworms. Some mealworms are now known to be hosts for some tapeworms. The eggs can be carried by the mealworm and hatch in a mammal's (including human) intestine where the tape worm can grow and flourish. This is not known to be a problem for wild birds. The only birds thus far known to be infected have been domestic poultry, not wild birds. These parasites have not been found on many insect farms. More work needs to be done but for now it appears the risks are very small and the risk to wild birds may be zero, or nearly so. So, unless you plan to consume a lot of mealworms (and human consumption is becoming more popular in Asia

and parts of Europe), I wouldn't worry about this issue at all. It's highly unlikely that the tapeworm eggs could survive the process of drying the mealworms so the risk of tapeworms from dried mealworms is nonexistent.

Mealworms should never be used as the only food source for birds but no responsible bird-feeding human does that; we all feed a variety of foods from season to season. Providing mealworms, whether dried or live, is a great and very, very safe way to attract birds into your yard. I encourage you to try them as an added treat to provide to the birds coming to your yard. They won't last long, especially live mealworms, but you will enjoy watching the many birds who love this food item.

We sincerely thank Ron Dudley for the use of his photo of a Loggerhead Shrike casting a pellet! Dan has long followed Ron's outstanding bird photography blog daily, and highly recommends his blog to all those interested in bird behaviors! Ron has the distinction of being the ONLY excellent source of songbirds casting pellets that Barbara Gleason could find! Thanks so much, Ron!

Ron's blog: <https://www.featheredphotography.com/>

The following post in Ron's blog is quite interesting about shrikes and their pellets, and we encourage our readers to learn more:

<https://www.featheredphotography.com/blog/2012/02/12/shrikes-pellets-and-photographers-frustrations/>

And here is another one about the interactions between a hummingbird and a wren, involving territoriality AND a pellet... enjoy!

<https://www.featheredphotography.com/blog/2019/06/19/house-wren-harrassed-by-a-hummingbird-and-throwing-a-pellet/>

Dan Gleason is a retired Biology Department faculty member from the University of Oregon. While serving on the faculty, he taught an ornithology course for seniors and graduate-level students in Biology. He is the author of *Birds! From the Inside Out* and *Looking For Yellowheads*, and has written numerous articles including a monthly article about birds in the local newspaper (Eugene Register-Guard) for more than 9 years. He has been a frequent guest speaker at Audubon Societies, Garden Clubs and other nature-oriented organizations and bird festivals for the past 30 years. In 2015, he and his wife Barbara, opened Wild Birds Unlimited in Eugene, Oregon. This shop sells high quality products and food for wild birds. A part of Dan's reason for opening this store was to continue providing educational material to the public about birds. The information is provided freely through written articles, direct conversation with people interested in birds and through lectures given in the store. (Because of Covid-19, these talks have been suspended. Once this is completely safe, these talks will resume.)