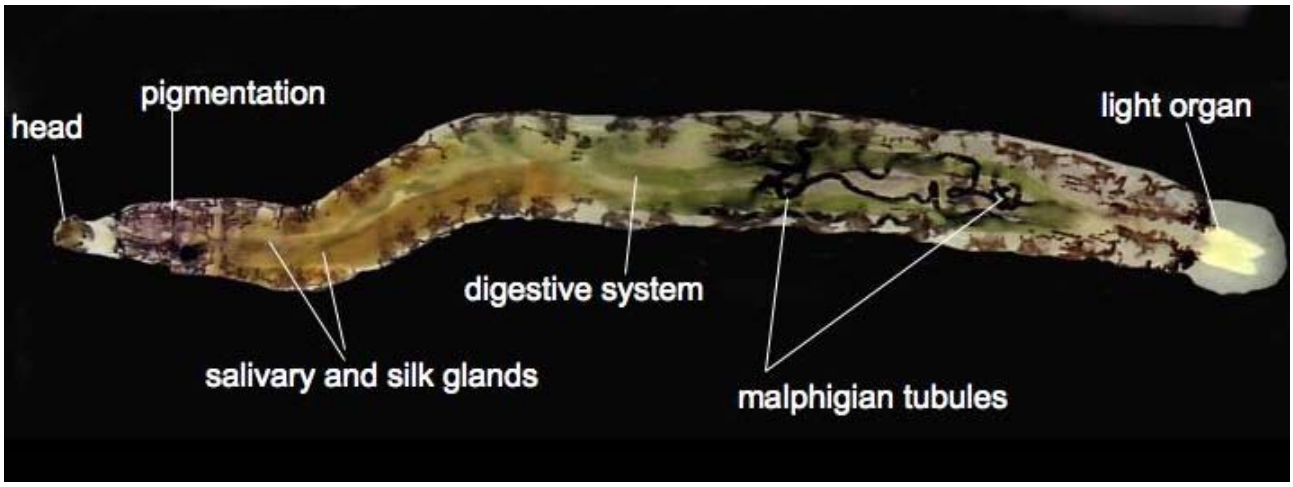
A diagram of a glow-worm.



GLOW-WORM POO

– Peter Chandler (with Dr. Claire Baker)

A glow-worm in its snare. Photo: Anthony O' Toole.

Late last year Waitomo was host to ACKMA Member Dr David Merritt, who is an entomologist based at Queensland University and an expert in glow-worms. He gave a presentation at the Waitomo Visitors Centre outlining some of his glow-worm study topics and answered questions from the floor. He also showed video footage of glow-worms fighting and drawing up their captured prey.

He was very keen to dispel the glow-worm myth widespread in New Zealand and Australian cave guiding circles – 'glow-worms have glowing poo'. He believes that this misconception stems from V.B.Meyer Rochow's 1990 Book, *The New Zealand Glowworm*, which in the summary says they use their modified excretory organs, the malpighian tubules, to produce light with waste products from their metabolism.

I was having trouble finding out from the literature if these critters have solid poo, so emailed ACKMA Member Dr Claire Baker, who was employed as the glow-worm expert for BBC programs filmed at Waitomo a couple of years back. I also asked her to explain 'malphigian tubules'.

This is Claire's response – comments in italics are mine.

Hi Pete,

Glow-worms do indeed have poo. But of course this does NOT glow! They discard their excrement (a tiny black smudge) outside the snare presumably to decrease fungal attack. I used a piece of filter paper under each glowworm to establish this for the Australian species. Their excrement does not travel through the light organ on a glow-worm. Adam Broadley mentioned their poo in his masters thesis too.

I have a similar problem with one of my guides with regards to what he tells tourists. He insists on saying it is their poo that glows despite many training days and seminars. It's just what is in his head and he can't seem to change! I think he thinks the tourists like it too... Tell them what they want to hear, he reckons. I am much more of the opinion that they need to be educated on our tours!

As for the bioluminescence, I recently wrote an article for a kid's magazine in the UK and used this to describe their glow production:

'How is glow-worm bioluminescence made?'
Very simply, bioluminescence is made when luciferin (a substrate) is oxidized by luficerase (an enzyme), to make oxy-luciferin. This, in turn, gives off light photons and carbon dioxide. ATP (adenosine tri-phosphate) powers the reaction. The luciferin of each species is slightly different and each group of bioluminescent organisms uses different mechanical systems to make and control the light.

In the case of our glow-worms, luciferin is made in the fused terminal segments of the malphigian tubules (SEE LABELED IMAGE), *(an insect's equivalent to kidneys).* These are thin, blind-ending tubes extending from between the mid and hindgut of the digestive system that

normally function in salt, water and nitrogen waste regulation. [*according to Dr Merritt, the location of the glow-worm's light producing cells at the ends of their excretory organs is pure evolutionary chance and has nothing to do with the insect's excretion process.]*

[Reading in Wikipedia, usually Malphigian tubules run out of the insects mid gut into their body space, which is full of hemolymph, the insect equivalent of blood. Insects have an open circulatory system in their body, so these Malphigian tubules remove waste products from this hemolymph.]

Glow-worms also have a large reflective organ, *CUT [in the shape of a lens]* made of a mass of fine tracheoles, located at the posterior tip of the glow-worm to shine the light out from the glow-worm's body.

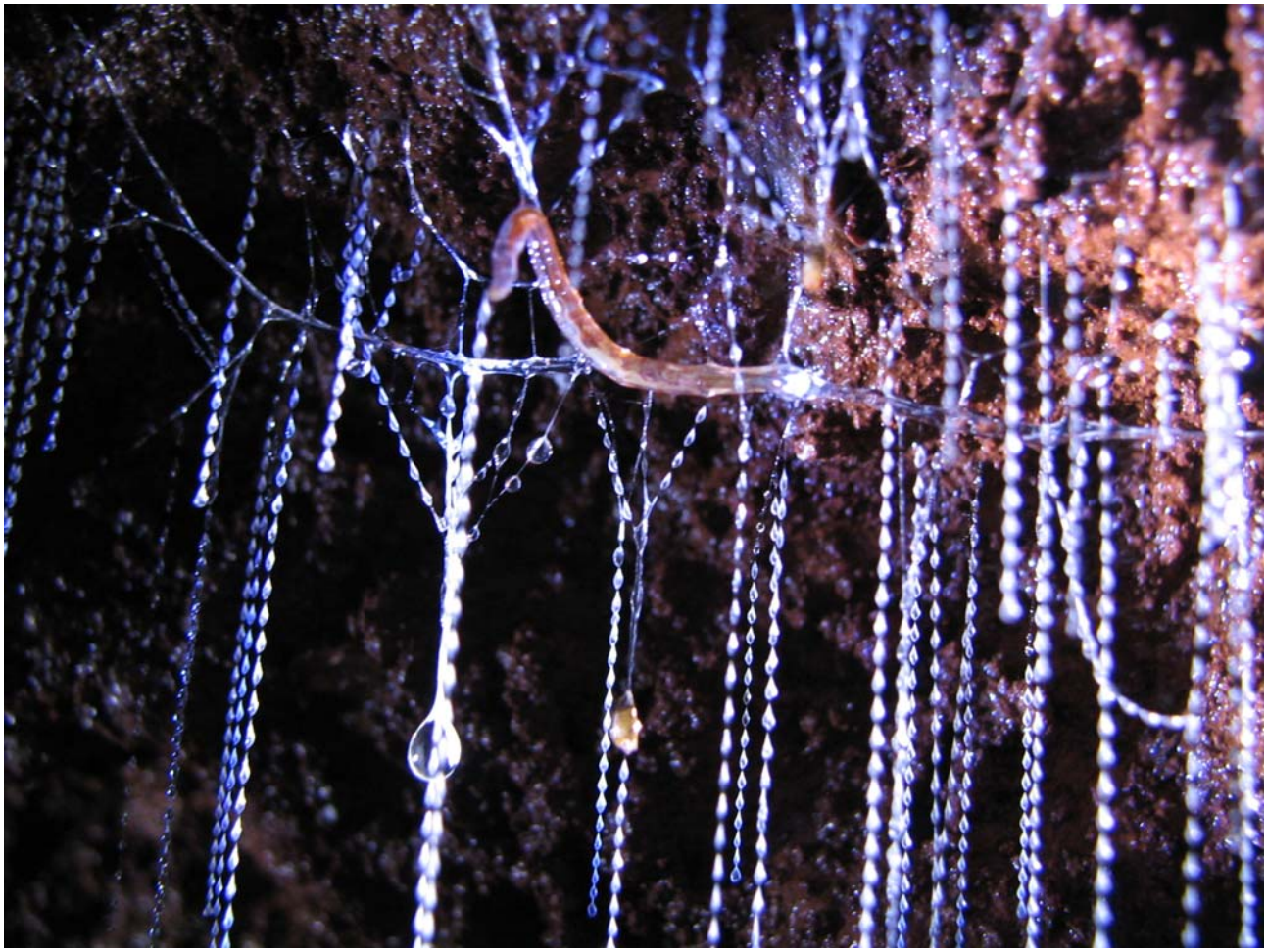
[Tracheoles are the thin tubes inside the insect's body which function to transport gases – oxygen in, carbon dioxide out to the atmosphere. Pete has shone a torch on a non glowing glowworm and seen this reflector, reflecting torch light back]. You can also see from the picture given that the flash of a camera reflects back white rather than the blue-green colour produced by the glow-worm.

During my PhD I visited and worked in a biotechnology company in San Francisco that was working on bioluminescent tags for cancer research and then headed to the Appalachian Mountains, Alabama to check out the US version of a glow-worm, *Orfelia fultoni*. They call them 'dismalites' there! Not a particularly appealing name.

The glow is a very white/blue glow that comes out of their final abdominal segments (as for the Australian/NZ species) as well as glowing from the thoracic region (just behind the head). The dismalites display can appear twice as dense as our species. Dismalites also live on leaves, dirt and any flat surface as they make flat sticky trap snares instead of hanging them down like ours do. They make the light in their fat body.

As for your question on what parts of their prey do they eat, I have observed very hungry glow-worms eat an entire insect, but mostly they will chew a small hole and only suck out the hemolymph (insect blood) and discard the empty exoskeleton.

Dr Claire Baker PhD, BSc (Hons), Entomology consultant. <bugsyclaire@yahoo.com.au>



Glow-worm suspended in its silken snare. The bioluminescence made by each glow-worm shines out through the reflector, located at the posterior end of the larva. Photo: Claire Baker.