An Introduction to Entomological Knot Tying

By Dr. John W. and Peggy Guyton

We have enjoyed sharing knot tying at festivals, field days, workshops and the Bug and Plant Camps that we run at Mississippi State University. And since we did not have examples of how others setup and managed knotting booths at festivals, we made up our version. We did not have "exhibits" to share, when we were first invited to share our hobby, so we had to come up with something. The first photo was our first entomological knot board and it is in the Director's office of the Mississippi State University Insect Museum.

We started by taking a few knot boards, patterns and supplies and Ashely's Book of Knots with which to tie knots. It did not take long to discover few could look at an Ashley diagram and tie the knot. So, we redrew them on our computer with enlarged lines and provided foam board and quilting pins for new knot tyers' use. And this worked! Along the way we created "touchy feely knots" that were large enough to pick up and handle, a knotted hat band for my straw hat and a necklace for Peggy, and a wider variety of knot boards.

As an Extension Entomologist I was drawn to Ashley's insect knots. Developing *entomological knots* involves a little creativity and the decision to utilize at least one defining characteristic of the insect being tied sometimes requires a little imagination on the part of the knot tyer and viewer! Ants, for example, have angled antenna and flies have only two wings. Insects have three body parts (head, thorax and abdomen), 6 legs and characteristic shapes. They have different life stages: egg, larva, pupa or cocoon and adult that can be illustrated with knots. The second collection features knots representing the stages of a moth's lifecycle. As the most abundant animals on the planet, arthropods, have even more differences on which to draw. We used knots to illustrate the life cycle of a moth for a thank you plaque designed for a moth authority who delivered a keynote address at a conference. We typically do not put legs on our insect knots and entomologists often leave the legs folded underneath insects when mounting them in collections. Other arthropods have characteristics including legs that are descriptive and can be used such as grasshoppers jumping legs, spiders that have 2 body parts and 8 legs; millipedes' long cylindrical bodies with two pairs of legs on each segment and up to 100 segments; and centipede's flat bodies with one pair of legs on each flattened segment up to 177 pairs.

As a fly fisher and fly tier, I considered writing this around the use of insects in fly tying. But my greatest expertise is with larger decorative knots, not intended for fish! There are beautiful collections of flies for fishing, and I have a couple on my office walls, but I have been unable to find a collection showing features of different insect orders. There is however, an enjoyable review of the history of fly tying by Michael Parrella in the American Entomologist, Spring 2013 titled "A History of the Entomology of Fly Fishing" (available online).

Co-opting knots is a logical and useful technique in tying knots that resemble insects. Our first insect knot was Ashley's Dragonfly (2467) and it is instantly recognized by everyone! In our collections we use

Ashley's Butterfly (ABOK 2469) and Moth (2471) knots and invert his Owl Knot (2472) as another Lepidopteran (butterflies and moths). The masthead knot (2295) *has 2 wings* and makes a nice fly. Those "annoying to most" flies only have two wings, the hind wing being replaced by small knobs that reminds me of a miniature drumstick, behind each wing. Also on that page is a masthead knot (ABOK 2296) with a single twist giving it a beautiful abdomen that could be another fly or bee (most do not object to a deformed bee with only 2 wings and many don't even know how many wings bees have - 4)! The caterpillar knot (2468) was easy and we make one with a smaller body and cut the loops making an ant with 6 legs. Ashley's 2462 with the loops pulled snug make a fine bug (Hemiptera order – or a stink bug). Ashley's 2301 and 2303 make good insects and Ashley was correct, 2314 is a bumblebee, albeit with only 2 wings (bees have 4)!

When you think about it, insects could represent a huge source of inspiration for tying knots. There are over 1,000,000 species (different kinds) of described insects and most authorities agree there are in all likelihood that many more undescribed. By comparison there is only one species of humans. The number of described insects is more species than all other animals and plants combined (80% of the world's species may be insects!). It has been estimated that, at any one given time, there are **10 quintillion** (10,000,000,000,000,000,000) live insects (Smithsonian). For comparison there are only 7.67 billion of us! The **oldest known insect fossil** (*Rhyniognatha hirsti*) **dates back 400 million years to the Paleozoic Era** while the **oldest known human fossil is only 4 million years old**. Insects play important roles pollinating plants and decomposing waste. E.O. Wilson is credited with saying, "If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed ten thousand years ago. If insects were to vanish, the environment would collapse into chaos." Alarmingly, insect numbers are plummeting! Less than 1% of insects are considered "bad" (termites, roaches, insects that damage food crops, mosquitoes, ticks, bedbugs, etc.). So, when you think about it, if your knot looks like a bug, it probably resembles one – whether you have seen it or knot (sic)! I had a frayed piece of cordage that I tied to a hook that successfully fooled fish! Unfortunately, insects are having trouble and that is not a good thing for humans or earth. I have found that popularizing knots that resemble insects provides a platform for building awareness of insects' great importance to life on earth, including our own.

We found some great bugs in Graumont and Hensel's Encyclopedia of Knots and Fancy Rope Work, and many knots we have co-opted. Breastplate Plate 139 knot 30 has a fine head, thorax and abdomen (three parts of an insect), and look at 34! Plate 146 has a dragonfly and we have used 124 and 126 as arthropods (insects are the largest group of animals in Arthropoda – the largest phylum in the animal kingdom). Bugs are also found on Plate 147, Numbers 132, 137, 141, 144, and 145! Same plate Numbers 136 makes a fine cocoon or chrysalis and 142, 144 and 145 could be a caterpillars. Add some fins to Plate 154 number 264 and you have a fine fish! But I digress. Back to bugs. Plate 155 has number 270 that must have been inspired by a bug! We have used 333 on Plate 159 (interlocking sailor's breastplate) for a ladybug. Number 4 on Plate 338 is the "Mathematical Design," for a horsefly!

And there are other places we find bugs. We received a potted plant in a woven basket with a design resembling a bug that was responsible for us keeping the basket after the plant died. We call that one a trashcan bug!

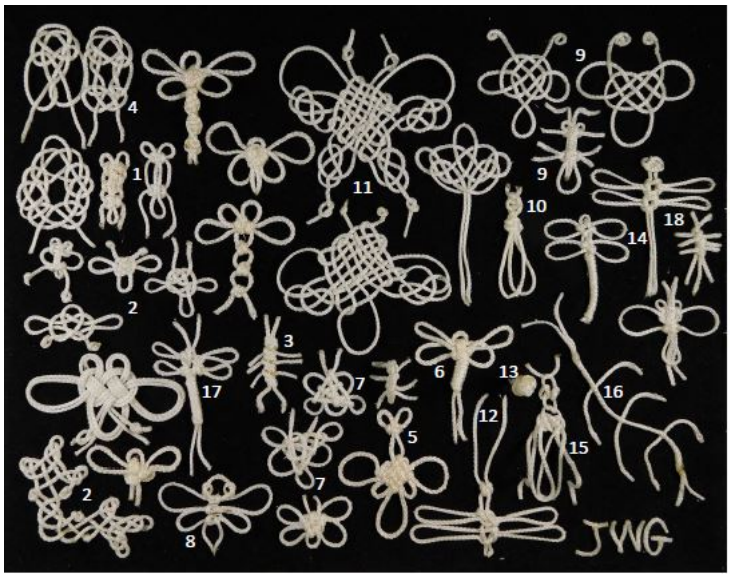
Insect Collections are often arranged alphabetically by orders. Insects are grouped in "families" under orders. Families contain insects in various Genera and Species. *Knot families* could be "ABOK," "EOK" (Encyclopedia of Knots and Fancy Rope Work by Graumont & Hensel), or highlight differences in the insect families. Many of our insects are hybrids (combination of knots).

A Few Entomological Knot Tying Tips

I prefer using braided nylon for entomological knots and keep a variety of diameters on hand. I have co-opted a small collection of sewing needles used in leather work into which I can thread a piece of nylon. With these needles I can easily push a piece of rope through another forming a cross or loop. I use art foam board for pinning boards. I also use a propane soldering iron to cut the nylon, and occasionally to "weld" pieces of nylon together (initials in collection).

Insect Order Notes

Insects and other arthropods, that are related, are grouped or categorized into "orders" and since science is self-correcting, these orders are continually changing! This section is to enable the reader to connect selected "Order" names with representative insects in the order. An insect identification book will prove essential. Each "order" below contains tying notes, and short fun facts about insects in each order. There are orders I did not include, for cause. This photo is a collection of insects representing the most common orders. And, there are several "species" for several orders.



The following notes are organized by insect order or category and each includes: Order number that matches illustration numbers on knot board, order name, number of species or different kinds of insects in the order, a few examples; and characteristics useful in tying insect knots in specific orders, and/or a fun facts if you take your entomological knots to a festival!

1. Coleoptera (Greek for sheath "koleos" and wings" ptera") Beetles**:** 400,000 Species or different kinds. **Examples:** Longhorn beetles, stag beetles, weevils, fireflies and ladybugs (flies are in the order Diptera not Coleoptera. When the word "fly" is used as a "compound word," as in this case, it does not imply firefly is in the "fly order" or Diptera and ladybugs are not in the "true bug" order Hemiptera they are beetles!). Beetles have 4 wings and an oval shape. It is said that God must have favored beetles since he made more of them than anything else!

2. Diptera (Greek for two "di" and "ptera" wings) Flies: 120,000 Species **Examples:** Flies, mosquitoes, gnats and biting midges. Flies have two wings and small "halteres" that resemble "drumsticks" behind each wing that auto rotates to control flight, with only two wings. Flies are fun to tether, with a thread carefully tied between their head and thorax, and allowed to fly in circles. We periodically do this at BugFest. If its head comes off – it was just a fly. If you have some extra horse flies snip off one or both halteres and observe it learning new skills to fly. Number 2 in the bottom left corner of the Entomological Insect Collection illustration features 2 flies that are conjoined "lovebugs," in love! An extra knot has been added behind the wings in these lovebugs representing halteres. Lovebugs are often brought to our office for identification, and are most often connected. I am not sure our very prim and proper clients see humor in their common name! But it's so much easier to remember and pronounce than *Plecia nearctica*, and we are quick to suggest they may also call them honeymoon bugs!

3. Dermaptera (Greek for skin or leathery “derma" and wings “ptera”) 1,800 Species **Example:** Earwigs. I have never heard of an earwig getting into a person’s ear and the ominous looking forceps (a useful feature in tying one) cannot even give a respectable nip! The forceps or pinchers on the abdomen is a determining characteristic of an earwig knot. Dermaptera is the smallest Order and earwigs are found on all continents except Antarctica and are moved great distances hitchhiking in luggage and shipments. They feed on dead plants and insects and are relatively unique for their maternal care!

4. Blattodea (Latin for cockroach; shuns light) 4,600 Species **Examples:** Cockroaches. Cockroach electronic backpacks are available that can be glued to their backs and connected to roaches’ antenna enabling you to drive them with a cell phone app! Cockroaches can also be tethered and used to pull a sled weighted with coins to enable a comparison of their weight vs. how heavy a load they can pull.

5. Mantodea (Greek referring to shape - prophet like) Example: Praying mantids. Mantids (4b) are fun to watch rocking back and forth and using triangulation to get a fix on their prey. And yep the female often makes a snack out of the male. Praying mantids are carnivorous ambush predators with martial arts dexterity that could have been accurately named preying mantids!

6. Ephemeroptera (Greek for half-wing) 2,100 Species **Example:** Mayflies. The mayflies abdomen’s tip have characteristic 2-3 thread-like tails (caudal filaments). The body is easily tied with a representative knot (4 wings) with two or three leads protruding from tip of abdomen. Mayflies, live for a day as adults with one thing on their small minds... …and it is not food! They emerge in huge numbers, many on the same day, mate, lay eggs in streams or ponds and die. The mayfly is a hot model for making fly-fishing flies and you will find them in most fly fishing fly collections!

7. Hemiptera (Latin for half-winged; known as "true bugs") 90,000 Hemipteran Species **Example:**, Leafhoppers, kissing bugs, spittlebugs, giant water bugs, bed bugs, and shield bugs. All bugs are insects but not all insects are bugs! (Entomological pun – “bug” technically refers to insects in the order Hemiptera!) Some “shield bug’s” bodies have triangular shapes and triangular knots can be worked into a “hemipteran.”

8. Homoptera (Latin for “equal wings;” known as “sucking insects”) 32,000 Species. **Example:** Cicadas (males sing to attract females), psyllids, whiteflies, spittle bugs and scale Insects. Honeydew, a sugar-rich liquid is sometimes excreted by sap suckers much to the chagrin of those standing or sitting under a tree they inhabit! A very small monkey’s fist beneath a “bug” would be a subtle clue to the sap sucker’s identity! The cochineal has a long history of use as the source of a red dye from the carminic acid it produces and a representative knot dyed red with cochineal dye would make the visual for a great story! Cochineals’ specialize on cactus and have a rich history.

9. Hymenoptera (Greek for "membrane wings") 130,000 Species. **Example:** Ants (have bent or angled antenna), bees and wasps. Bees navigate by the sun and can see polarized light thus determining their position on cloudy days. The sunstones of the Vikings were probably calcite and gave them this capability. Calcite splits a beam of light into two rays. By adjusting the position of the calcite crystal such that the two rays are of equal intensity will reveal the position of the sun, even with cloud cover and when it has just dropped below the horizon. Bees and wasp can easily bee trained to search for a specific color sugar water.

10. Isoptera (Greek for "equal wings") 2,300 Species. **Example:** Termite. Very small and in a collection, you might want to place your termite knot on a piece of termite damaged wood. The ink in some pens contains a chemical that mimics termites' chemical trail. Sketch a circle on paper, with a ballpoint pen and sprinkle a few termites in its center. If they do not line up on the line and follow it, try other pens until one works. Termites can have wings that are twice as long as their bodies and their abdomens appear to be composed of segments that can be replicated by wrapping them from the waist to tip with cord.

11. Lepidoptera (Greek for "scale wings") **Species: 300,000.** Butterflies' and moths' wing patterns and colors are descriptive. Touching a moth wing under the porch light at night will reveal scales on your finger, from the moth. If you like butterflies you will love to know there are around 20 moths to every butterfly. They are easily attracted to a black light hung, at night, in front of a sheet. Butterflies and moths do not eat solid food and use their proboscis to drink. If you want to go one step further with your Lepidoptera knot, add a curled proboscis under its head.

12. Megaloptera (Latin for "ample wings") **Species:** 400. Dobsonfly, alderflies, hellgrammites, and fishflies. Their larva are indicators of good water quality. The male dobsonflies have fearsome looking mandibles that have resulted from a sex selected trait. Males with the longer mandibles can flip their competitors off the limb, and get the contested date! Long mandibles on the front of a body knot are a defining clue to the insect's identification as a dobsonfly. Dobsonflies are nocturnal and we have silly friends who were horrified and declared they are a reason to not go outside in the evenings!

13. Neuroptera (Greek for "net-veined wings") **Species:** 5,000 **Examples:** Lacewings and antlions. A lacewings egg on its stem is featured in this insect knot collection ant is a small monkey's fist with a centimeter of line still attached. The eggs are often found in groups supported on stems. A pin can be pushed through the Turks head and down through the line for mounting in a collection!

14. Odonata (Latin for "toothed" referring to mandibles) **Species:** 5,500 **Example:** Dragonfly and damselflies. Understanding insects' behavior enables collectors to be more successful. Dragonflies, for example, fly in a back and forth search like pattern. If you miss netting them on an attempt just wait, they will be returning to give you another chance! Dragonflies rest with wings spread and damselflies with them folded over their backs. Dragonflies have been around for over 300 million years and were among the first insect fliers. Dragonflies today have wingspans of only two to five inches, but some dragonflies fossils feature wingspans two feet wide.

15. Orthoptera (Latin for "straight wings;" back legs large and built for jumping) **Species:** 20,500 **Example:** Crickets, grasshoppers and katydids. Only male crickets chirp and the warmer it is the faster their rate of chirping. This can be tested by releasing male and female crickets inside and waiting for the male to begin chirping. Count its chirps in a minute. Note the temperature and adjust the thermostat to a different temperature and count the next set of chirps. Crickets "ears" are on their forelegs and you can watch the female moving her legs around to get a fix on the male's location, when he is chirping. I should mention, crickets are good to eat!
Count the number of chirps in 15 seconds then add 37 to get the temperature in degrees Fahrenheit or for degrees Celsius, count the number of chirps in 25 seconds, divide by 3, then add 4 to get the temperature.

16. Phasmatodea (Greek for “phantom”) **Species:** 2,500 **Example:** Walking Sticks and leaf insects. An important entomological knot tying tool is a soldering iron if you work in nylon and this is useful in attaching walking stick legs Of course you can use a needle to make a hole and push the legs through the body. If you gently hold a live walking stick with your index finger and thumb and roll it back and forth you can induce a trance and pose it for a photograph or amuse young knot tyers.

17. Plecoptera (Greek for “folded wing”) **Species** 3000 **Example:** Stoneflies are an indicator of good water quality. They use reflex bleeding or squeeze out drops blood to fool predators. Your stonefly knot should have long antenna, a pair of anal cerci, and two pair of wings.

18. Thysanura (Greek for “fringed tail” or "bristle tails") **Species:** 370 **Example:** Silverfish are prehistoric, predating the dinosaurs and are possibly the earliest most primitive insects. They have silvery scales and move in a wiggling motion reminiscent of fish and frequently outrun their predators that include spiders. They eat vegetable matter, paper, glue and can often be found in libraries and old books. They have complex courtship rituals!

If you enjoy tying Entomological Knots, we would enjoy hearing from you and even seeing and learning some of the knots you develop. If you decide to play with the bugs you are tying, that would be interesting to hear about as well!