Art Constantino has generously provided the BCBC with directions on growing coonties for those of you who wish to generate additional coontie (*Zamia pumila* = *Zamia integrifolia*) plants for adult Atala butterfly oviposition (egg-laying) sites and larval (caterpillar) food in your butterfly gardens. Art has put years of practical, hands-on expertise into this presentation and we are sure you will find his step-by-step guidelines easy to follow and helpful. We thought a few preliminary comments may be in order, especially if you have never tried growing coontie from seed or dividing the calyx (root stock) of large coontie plants.

All cycads are highly toxic plants, containing abundant levels of cycasins and other neurotoxins that cause liver necrosis, gastric distress, neurologic damage, and death *if ingested*. In the 1800’s, several sailors from Captain Cook’s explorations died because they were so hungry that they ate some of those pretty red seeds from North America’s only native cycad, coontie. Florida’s first European settlers documented the deaths of dogs, cattle, and other domestic animals dying from drinking water contaminated with cycad run-off as the settlers tried to prepare flour from the roots…..but that’s a long story (see Sandy Koi’s blog, [http://e-atala.blogspot.com](http://e-atala.blogspot.com) for the post called “Coontie Crazy”).

That said, please be aware when handling the roots, leaves, seeds, and cones that all parts of any of the beautiful cycads should be handled with care. The toxins are water soluble, though, so wash your hands and garden tools thoroughly with soap and water after using them on coontie (or other cycads) and before using them on other plants. By the way, the cut stems and the flesh covering the seeds will ‘bleed’ the chemicals; this red fluid will stain your clothes and will not wash out. It is an amazing fact that Atala butterfly caterpillars, Echo moth larvae, various scale insects, and molds survive and even thrive on this plant!

When collecting seeds for growing, it is probably best for the plant’s health that the seeds from female coontie cones are collected after they ripen and fall apart on their own, rather than trying to separate the seeds from an unripe cone. The seed cones from female plants are thick and the seeds are surrounded by bright red-to-orange flesh called “sarcotesta” when ripe (Figure 1). The male cones are tall and slender and are filled with dusty pollen when ripe (Figure 2).
Figure 1. A female coontie plant (*Zamia pumila*) has thick cones and red-orange seeds, not yet ripe in this photo. (Photo by S. Koi)

Figure 2. A male coontie plant (*Zamia pumila*) has narrow, tall pollen-filled cones. These cones are not yet producing pollen. (Photo by S. Koi)
A little side-excursion into cycad biology: all cycads are dioecious, which means that there are both male and female plants. Each cycad species has specific, sometimes obligate (necessary), insects associated with it, including specialized butterflies and weevils (a particular kind of beetle). The insects all have a mutually beneficial relationship with the plant. The cycad provides food and shelter to the butterfly larvae and weevil offspring. In return, the larvae of both butterflies and weevils provide organic nutrients for the plant via their frass (waste product). The adult weevils also pollinate the cycads by transferring the heavy pollen from the male cones to the female cones. The weevils may sometimes be found clustered in large groups around the cycad cones during mating season, usually early fall.

Our native coontie, *Zamia pumila*, is unusual in that it may be pollinated by two species of weevils, *Rhopalotria slossoni* (Figures 3 and 4) or *Pharaxonotha floridana (=zamiae)* (Figure 5). The important thing is to not mistake any little beetles you see on your cycads for “bad guys” even if you find them eating parts of your plant, because their ultimate job is to pollinate the seeds. You may not see weevils until your plants are mature enough to form cones.

Figure 3. The coontie cycad weevil, *Rhopalotria slossoni*, which measures about 1/4 inch in length. Male weevils in this species have enlarged femurs (upper leg joints) which are indicated by the arrow. (Photo by Michael C.Thomas)
Figure 4. The coontie cycad weevil *Rhopalotria slossoni*, side view. Notice the “beak” on this type of beetle, used for piercing plant tissue (Photo Louisiana State Arthropod Museum)

Figure 5. The other coontie weevil associated with *Zamia pumila*, *Pharaxonotha floridana*. It is about the same size as *R. slossoni*. (Photo Michael C. Thomas)

Some of us may prefer to allow nature to germinate the seeds on their normal schedule, which generally occurs the next spring and summer after the seeds ripen. For those who like to help nature along, Art’s detailed instructions provide great guidelines.
Either way, any new seedlings should be best moved away from the parent plant, as the female plants will emit a chemical in the soil that will kill any seedlings close to her. This allows her to grow bigger without competition from her offspring. The new seedlings will also need to be protected from adult female Atalas, who will oviposit on new seedlings, even those with only one leaf. Female Atala butterflies have a physiological need to unload their eggs, whether on a new frond, an older frond, or a cycad cone. Atalas may also oviposit in clusters containing as many as fifty or more eggs at a time (Figure 6).

Figure 6. Atala females may lay as many as fifty or more eggs at a time on a single frond. Each newly hatching larva is less than a millimeter in length. (Photo by Sandy Koi)

The young caterpillars need tender new growth because their tiny jaws are not yet strong enough to chew on older, tougher leaves. Obviously, this will quickly kill a new seedling and there is not enough food to feed even one Atala caterpillar if the plant has only one or two new leaves (Figure 7).
A fresh new frond can be cut and temporarily placed next to the natal leaf (the leaf on which the larvae hatched), allowing the neonates (newly hatched larvae) to transfer themselves to the fresh leaf. That leaf can then be placed onto a plant with new growth for the larvae to eat as they grow. Using a floral tube for the cut frond will keep it fresh while the transfer completed (Figure 8).
We suggest keeping new seedlings in a pot housed within an indoor screen enclosure or covering the seedlings with netting for six months to a year. This allows the plant to develop a strong root system before subjecting it to the severe herbivory (damage caused by consumption of the plant) that caterpillars or beetles may cause. Plant the new seedling so that the calyx, or rootstock, is just slightly peeking out above the soil line. Allowing the calyx of your established plants to remain above the soil line is important, too. As the plant grows, the calyx will grow larger and wider, which may require moving soil away from the root stock to allow for its expansion.

A convenient method for covering the plants entails using a tomato cage as a frame. These “cages” are found in the gardening section of many stores. The prongs can be pushed into the ground, or cut shorter if you live on a limestone substrate with little topsoil. The cage can also be turned upside down so that the wider part acts as a base around your plant, and the prongs bent together “teepee-style” to form the roof (Figure 9).

Figure 9. The completed tomato-cage with netting used to protect coontie seedlings from ovipositing female Atalas. (Photo by Sandy Koi)
Cover the cage with netting or other closely-woven fabrics, such as bridal veil material or tulle, all available at fabric stores. Netting at the base should be buried in the ground if it is left outdoors in the garden, and firmly sealed with non-rusting clothespins, plastic bag “twisties,” or plastic clamps; fold the fabric over once or twice before clamping it shut.

This completely prevents entry by female Atalas, which will flatten their wings “airplane style” and crawl under and between very tight spaces in order to access the new leaf growth. However, this lightweight enclosure will prevent ovipositing and consequent herbivory, still allowing the plant to breathe, and receive needed rain and sunshine (Figure 10). If the leaves touch the netting, the Atala may attempt to lay eggs through it.

Figure 10. A protective cycad enclosure, made with a tomato cage, netting and clamps. The female Atala is blocked from entering, although she is attempting to do so. (Photo by Janice Malkoff)
Another inexpensive, easily set up, dismantled, and washable option is a collapsible mesh laundry basket, sometimes called a pop-up hamper, found at housewares stores (Figure 11). Again, it is very important to bury the edges of the bin into the ground or pile mulch or leaves around the base, as the female Atala will scoot beneath barriers to oviposit on the coontie seedlings.

Figure 11. An inexpensive collapsible mesh “pop-up hamper” cage can also protect young seedlings from ovipositing. Be sure to bury the edges into the ground or pile mulch around the base. (Photo by Sandy Koi).
Coontie and all cycads are extremely slow-growing plants, taking years to develop into well-established large plants. Large-scale commercial harvesting of coontie plants for starch by the European settlers in the early part of the twentieth century caused the plant to become rare in the wild. Because the Atala is an obligate, specialist insect whose larvae eat only cycads, that exploitation nearly extirpated (eliminated) the Atala butterfly from south Florida. (Echo moth larvae are able to survive on many other plants, as well as coontie, so the exploitation of coontie did not affect them). This is why planting coontie in butterfly gardens and natural areas has been instrumental in the partial recovery of the Atala butterfly. Although there are natural and introduced colonies of the butterfly found in many areas in South Florida now, most are “ephemeral,” meaning that they often disappear or die out within a year or two. Long-term research indicates that there are less than 100 colony sites that have persisted uninterrupted for three years or more since 2001 (Koi, unpublished data).

It is normal for plants to become stressed, especially in the winter, and especially if they have suffered severe herbivory. Cycads may also become infested with scale or sooty mold when this occurs. Cut the plant’s fronds back to remove damaged or diseased leaves and destroy them, so that new growth and other plants are not inadvertently infected with these pathogens. This is the best time to provide some extra nutrients via a recommended fertilizer or used coffee grounds. Cycad expert Tim Broome has written that “coffee-sun-tea” may also help protect the plants from scale infestation. Visit his website “Cycad Jungle” for more extensive information about cycads, types of fertilizers, and propagation.

Coffee fertilizers are one type of nutrient suggested by Broome and are something we can vouch for, as this is an inexpensive method of providing essential, readily available nutrients for your plants. Coffee contains alkaloids and nitrogen, which are beneficial for cycads. Coffee grounds are often available free from coffee houses, but another word of caution: use the grounds the day you collect them or they will get moldy and be unusable! The best way to apply the coffee grounds is to distribute them about an inch thick around the base of the plant, near, but not touching, the calyx (exposed root).

If a cycad is stressed from repeated herbivory for a long period of time, it may die because the root stock is depleted of stored energy and there are no leaves to provide more energy for growth via photosynthesis.

Also, if you want to attempt calculating how much food your coontie plants potentially contain, visit the Institutional Repository at the University of Florida to download the rubric Sandy Koi created. It determined how much leaf material differently-sized coontie plants contained, how many caterpillars it could potentially feed, and allows you to make a rough comparison to your own plants.

Happy Propagation!
Glossary:
calyx: the crown of the root stock of cycads
dioecious: having both male and female individuals in a species of plant
ephemeral: transient, short-lived
extirpated: eliminated from an area (not extinct, but no longer found in an area)
femur: the upper leg joint of an insect
frass: solid insect waste material
herbivory: damage caused by an insect or animal consuming plant material
larva: caterpillar (singular); larvae (plural)
mutually beneficial: both species in the relationship receive some benefit from the relationship
natal frond: the leaf on which insect eggs hatch
neonates: newly hatched larvae (first instar)
obligate: having a necessary association with in order to survive
oviposition: egg-laying (used in reference to insects)
sarcotesta: the fleshy coating on cycad seeds
specialist: adapted to and dependent on one particular type of food
weevil: a type of small beetle

*The taxonomic names of plants and insects may change over time as new information is discovered, especially with the advent of molecular genetic work. The scientific way to designate that change is to use an equal sign after the current name to show that it is a synonym for the former name. For example, *Zamia pumila=integrifolia* indicates that *Zamia pumila* is the currently accepted species name, and that it was formerly known as *Zamia integrifolia*. (This is actually one instance where the common name, coontie, may be more recognizable than the constantly changing taxonomic name.) Adding to the confusion, not all scientists agree with each other about the accepted name, nor are all websites up to date. The taxonomic names used in this paper are from the Atlas of Florida Vascular Plants, and the latest published literature in the book American Beetles, Vol. II by Ross Arnett, et al. (ISBN 0849309549).

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