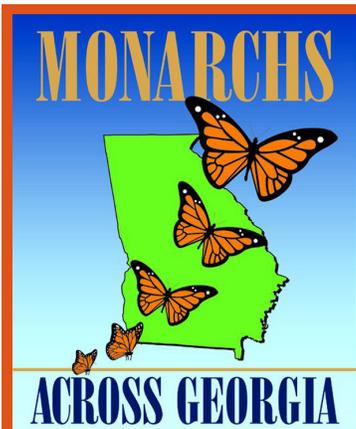


# The Chrysalis



Emerging News from Monarchs Across Georgia

A Committee of the Environmental Education Alliance of Georgia



## Upcoming Events

**Pollinator Week**  
June 18 - 24  
[www.pollinator.org](http://www.pollinator.org)

**National Moth Week**  
July 23 - 29  
[nationalmothweek.org](http://nationalmothweek.org)

**Monarchs Across Georgia  
Teacher Workshop**  
August 24-25  
Friday, 5:00pm - 8:00 pm  
Saturday, 9:00am - 4:00 pm  
Watson-Brown Foundation,  
Thomson

*For more information about these events or to register, please visit [www.monarchsacrossga.org](http://www.monarchsacrossga.org) or find us on Facebook!*

## Spring Arrives on Monarchs' Wings

The northward journey of Monarch Butterflies from Mexico back to Canada has already begun. By the first week in April, the graceful orange, black and white fliers will be touching down in Georgia to lay eggs as they head further north. If you have milkweed in your garden you may just be lucky enough to find caterpillars hatching on your plants. The joy of watching the monarch metamorphosis can then be yours.

All butterflies lay eggs. Many lay their eggs on one type of plant while some choose a smorgasbord of different grasses, flowers, shrubs and trees. The monarch is very specialized; there is only one plant on which they lay eggs – Milkweed. If you have milkweed, look underneath the leaf for a tiny whitish egg. If the egg has already hatched, look for the tiny green caterpillar. Usually they leave a single egg per plant, spreading their eggs to many “baskets” as this increases survival of the precious offspring.

Milkweed has been the bane of dairy farmers for centuries. When eaten by cows, it can make the milk poisonous and the cows sick. The plant has been aggressively eliminated from many fields. Luckily, most of us do not have cows on our porches, balconies, or yards and providing milkweed for monarchs is easy. Just plant some in flower pots, your garden, or sow the seeds in ditches and the edges of your yard. In Georgia, Swamp Milkweed, Butterfly Weed, and Common Milkweed are the best to plant. Check [www.monarchsacrossga.org](http://www.monarchsacrossga.org) under “Educational Resources” to see which species are native to your area and information on plant nurseries where you can obtain milkweed.



A newly hatched monarch with its first meal.

Monarchs can also be raised in cages for students and others to observe the miracle of metamorphosis. There is much to be learned about these exciting insects. For more information about monarchs, gardening for pollinators, and lesson plans, check out the Monarchs Across Georgia website.

As the caterpillars (cats) hatch, they eat their eggshell as the very first meal! Then they are on to chomping on the leaf, their only food as cats. As they grow, they shed their skin four more times. After the fifth instar, another miracle happens - they attach themselves to a leaf and form the chrysalis. The monarch's jade green chrysalis is one of the most beautiful sights in nature. After about 2 weeks, the butterfly emerges and pumps liquid into its wings. The wings dry for a few hours, then the adult takes flight.

## Decline of monarch butterflies overwintering in Mexico: Is the migratory phenomenon at risk?

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### THE DECLINE IN MONARCH ABUNDANCE

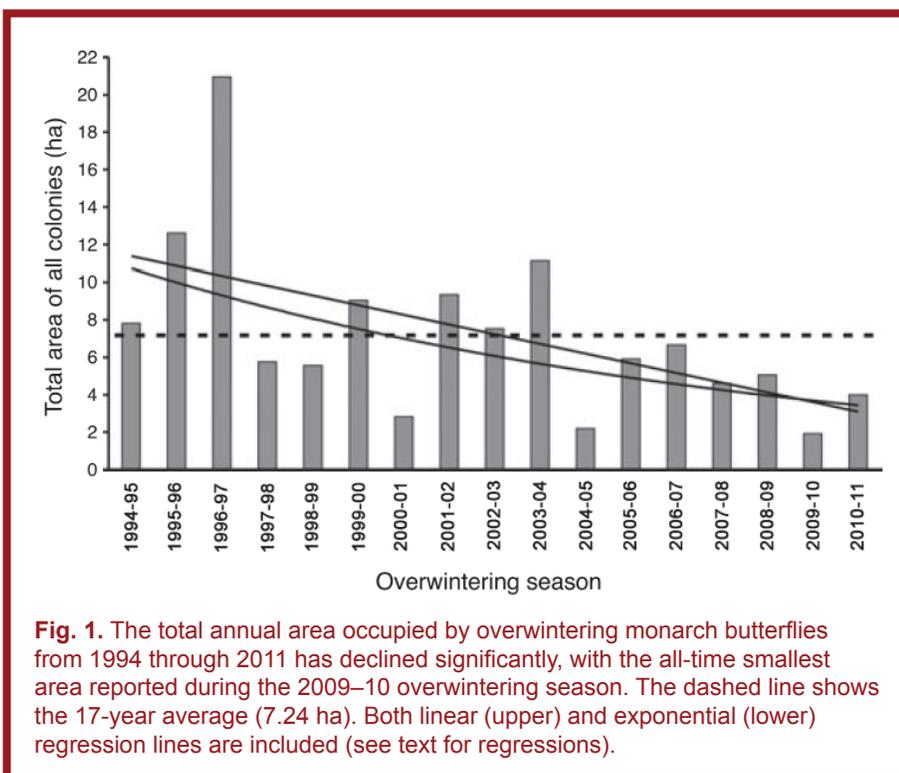
Wilcove (2008) has warned of the potential collapse of numerous animal migrations, including the unique migration and overwintering biology of the eastern North American population of the monarch butterfly, *Danaus plexippus*. During the 2009–2010 season and following a 15-year downward trend, the total area of overwintering colonies reached an all-time low (Rendon-Salinas et al., 2010; Fig. 1). Yearly monarch abundance is assessed by measuring the combined area occupied by all known overwintering colonies in Mexico, and these data have been published online by World Wildlife Fund-Mexico since the 1994–1995 overwintering season, with data to 2001 also available in Garcia-Serrano et al. (2004). The average area occupied by the butterflies over the past 17 years is 7.24 ha, with a maximum of 20.97 ha during the 1996–1997 season and a minimum of 1.92 ha during the 2009–2010 season,

and recovery to only 4.02 ha during the 2010–2011 season (Rendon-Salinas et al., 2011). The 1996–1997 overwintering season was monitored by Garcia-Serrano and Mora-Alvarez (1999) and also by a separate federal team of investigators (PROFEPA) (reference in Bojorquez et al., 2003), and we are confident that it was the largest recorded over the 17 years for which we have an adequate database. All of the past 7 years have been below the 17-year average. We have analysed these data and found that the decline is statistically significant.

To assess the time dependency of the measurements of colony area, we considered two regression models using the 17 years' data from Rendon-Salinas et al. (2010, 2011), with 1994 as year 1: a linear model, because it provides the simplest relationship between the time and area variables, and an exponential model, because it is the model frequently

used to analyse population growth. We first examined the data for independence of successive years' measurements and found no evidence of autocorrelation (Durbin-Watson test, 4-d = 1.538, with critical dU = 1.371; P > 0.05). Both linear and exponential regressions showed a significant decline in total colony area (Fig. 1; analysed with SPSS 2010): the linear model  $y = 11.89 - 0.52x$  was significant at P = 0.018, with F<sub>1,15</sub> = 6.989, and the exponential model  $y = 11.52e^{(-0.071x)}$  was significant at P = 0.015, with F<sub>1,15</sub> = 7.601. The r<sup>2</sup> values were 0.318 and 0.336, respectively. We also ran polynomial regression models, but they did not increase r<sup>2</sup>.

Reliable information on colony sizes and locations is available since the 1994–1995 overwintering season; earlier information was gathered on increasing numbers of colonies as they were discovered by



**Fig. 1.** The total annual area occupied by overwintering monarch butterflies from 1994 through 2011 has declined significantly, with the all-time smallest area reported during the 2009–10 overwintering season. The dashed line shows the 17-year average (7.24 ha). Both linear (upper) and exponential (lower) regression lines are included (see text for regressions).

diverse groups of investigators with variable expertise. Even though the data span only 17 years, the decline is statistically significant. The regressions remain significant when either extreme measurement (high in 1996–1997 or low in 2009–2010) is removed (linear model,  $P = 0.032$  or  $0.042$ ; exponential model,  $P = 0.040$  or  $0.049$ ). We believe that all the measurements we have analysed are reasonably reliable. Continued monitoring will, of course, strengthen conclusions about trends in monarch abundance.

### FACTORS LEADING TO DECLINING ABUNDANCE

Three factors are implicated in the downward trend in the monarch's abundance: (i) the loss of and reduction in quality of critical overwintering habitat in Mexico through extensive illegal logging; (ii) the widespread reduction of breeding habitat in the United States due to continuing land development and the killing of the monarch's principal larval food plant, the common milkweed *Asclepias syriaca* (Asclepiadaceae), because of increased use of glyphosate herbicide to kill weeds growing in genetically engineered, herbicide-resistant crops; and (iii) periodic extreme weather conditions, such as those that occurred most recently in 2009, that decrease both the spring breeding in Texas and the subsequent spring and summer breeding generations in the eastern USA and southern Canada.

### FOREST DEGRADATION

On the 12 known massifs that host the butterfly colonies in Mexico (Slayback et al., 2007), illegal logging has eliminated overwintering habitats on several and severely degraded them on others. For example, between 1971 and 1999, 44% of the high quality over-wintering forest was degraded within the area that became protected as the Monarch Butterfly Special Biosphere Reserve by presidential decree in 1986 (Brower et al., 2002). Then, between 2001 and 2009, after the new 2000 presidential decree enlarged the Reserve core zone to 13,552 ha, 1349 ha (10%) were severely degraded or clear cut (Anonymous, 2009). Colony areas that have been entirely lost include several on the north face of Cerro Pelon (Ramirez et al., 2008; L.P. Brower & D. Slayback) and at least three areas in the Lomas de Aparacio area on the southern portion of the Sierra Campanario (Brower et al., 2008). Colony areas that have been logged to the point at which few monarchs still aggregate include the west face of Cerro Pelon and the south face of Cerro Altamirano. Even the two principal ecotourism colony areas, Rosario and the Sierra Chincua, have been degraded by incremental logging over the past two decades (L.P. Brower, in prep.).

### LOSS OF BREEDING HABITAT IN THE UNITED STATES

Seiber et al. (1986) and Malcolm et al. (1993) determined through thin layer chromatography that 85 and 92%,

respectively, of 394 and 382 overwintering monarch butterflies in Mexico had fed as larvae on the Common Milkweed, *Asclepias syriaca*. The importance of *A. syriaca* reflects history of the landscape. A rich pre-colonial milkweed flora was widely distributed, with 29 species of *Asclepias*, most of them grassland species (Woodson, 1954; Hartman, 1986) native to the late summer breeding range of the monarch (Malcolm et al., 1989, 1993; Wassenaar & Hobson, 1998). However, ploughing of the prairies and deforestation led to an increase in the distribution and abundance of *A. syriaca* (Brower, 1995), which Woodson referred to as the pre-eminent weedy North American milkweed. Now with an increasingly patchy distribution, this species is the dominant milkweed in the monarch's eastern North American breeding range.



Satellite images of the Lomas de Aparicio monarch colony in Mexico taken in March 2004, left, and February 2008, right. Areas that were green and are now brown have been logged.

A survey in 1999 of habitats containing this milkweed species showed that the number of monarchs produced per ha in maize (corn) and soya (soybean) fields was as high or higher than that of other habitats (Oberhauser et al., 2001). Genetically modified glyphosate resistant (GR) soya and maize (e.g. Monsanto's Roundup Ready crops) were rapidly adopted by growers after 1999, resulting in a significant reduction of *A. syriaca* and the loss of monarch breeding habitats in these croplands. Much of the combined acreage of soya and maize (60–70 million ha per year) is used in rotation, and this rotation in combination with the high adoption rate of GR soya (>70% by 2002, presently 92%) and maize (presently 23%) (U.S.D.A., 2010a) has all but eliminated *A. syriaca* from 40 million ha of these croplands (Taylor, 2008). Both Hartzler (2010) and J.M. Pleasants (in prep.) have documented the drastic reduction of *A. syriaca* growing in glyphosate-treated fields in Iowa; Hartzler recorded a 90% loss from 1999 to 2009, and Pleasants measured a 79% loss from 2000 to 2009. We conclude that, because of the extensive use of glyphosate herbicide on crops that are genetically modified to resist the herbicide, milkweeds will disappear almost completely from croplands. Furthermore, Zalucki and Lammers (2010) have estimated

with models that the large-scale elimination of milkweeds in agricultural and surrounding landscapes has the effect of increasing the search time for host plants by monarch females with the result that realised fecundity is reduced.

In addition, milkweed habitat has been lost due to increasing demand for biofuels. Conservation Reserve Program (CRP) area has been decreased by 2.3 million ha since 2006 (U.S.D.A., 2010b) and as yet undetermined but large areas of grassland and rangeland have been converted to biofuel crops, especially maize (Stubbs, 2007). Over this same interval, maize and soya planting increased by more than 5 million ha (U.S.D.A., 2010a, and previous year reports from the USDA National Agricultural Statistics Service). Coupled with the habitat lost to development, which has been calculated as nearly 1 million ha each year from 1992 to 2007 (U.S.D.A., 2003, 2009), these losses add to at least 56 million ha (roughly 220 000 square miles). This is more than one-fifth of the estimated eastern North American summer breeding range of the monarch (Brower, 1999). The cost to the monarch population of habitat loss due to GR crops, increased planting of maize and soya, in addition to development is surely significant.

#### EXTREME WEATHER

Severe cold threatens the survivorship of overwintering monarchs, and spring and summer weather that is too cold or too hot lowers breeding season survivorship and fecundity and alters larval growth rates. In the spring of 2009, first-generation monarchs in Texas were negatively affected in March by above normal temperatures. Subsequent low temperatures in the corn (maize) belt, the third lowest in 42 years, limited growth of the summer generations. These climatic factors severely reduced the numbers of butterflies in the fall migration to Mexico (Taylor, 2009).

Then, during the 2009–2010 overwintering season, the butterflies were subjected to a record-breaking amount of precipitation during the dry season (Brower et al., 2010). From 31 Oct 2009 through 31 Mar 2010, 577 mm of precipitation fell, compared to 40 mm and 20 mm over the same time span for the previous two seasons, as recorded by the electronic weather station (Model 232; WeatherHawk, Logan, UT, USA) we established on the Sierra Chincua at the El Llano las Papas Field Station. This station is at the same elevation (3160 m) and 2–4 km from a principal overwintering area (Brower et al., 2009). From 31 January to 4 February 2010, the WeatherHawk recorded 360 mm of rain. Associated heavy winds blew down hundreds of oyamel fir trees in the core zone of the Reserve (pers. obs., Mar 2010). A low temperature of -3.2 °C occurred as the skies

cleared immediately after the storm; the second morning, after the butterflies had dried, the temperature dropped to -6 °C.

The 5-day storm caused major flooding, landslides, structural damage, and loss of human life (Elorriaga, 2010). Local observers (e.g., Rodriguez, 2010) reported that high winds associated with this and several less severe storms scattered the butterflies from their bough and trunk clusters. According to Anderson and Brower (1996), the low temperature recorded immediately after the storm could have killed 5–10% of the wetted butterflies. Had the drop to -6.0 °C occurred while the butterflies were still wet, rather than on the second morning when they were dry, more than 90% mortality could have occurred. Interviews of scientists, tour leaders, and tourists who visited the overwintering monarch colonies subsequent to the storm led Taylor (2010) to conclude that 50% of the monarchs died. Thus, this storm, combined with the lowest number of overwintering monarchs yet recorded, could have resulted in such a reduction in the number of remigrating spring butterflies that recovery of the eastern North American population would have required several breeding seasons. Nevertheless, the butterflies increased to 4.02 ha in 2010–2011, although this value is still well below the 17-year average of 7.24 ha. The frequency of severe precipitation events is likely to increase with climate change (Oberhauser & Peterson, 2003; IPCC, 2007).

#### OUTLOOK

The unique migratory phenomenon of the monarch butterfly has been designated as an endangered biological phenomenon (Brower & Malcolm, 1991). Concerns about breeding habitat and overwintering forest habitat loss were central issues in a Commission for Environmental Cooperation conference held in Morelia during December 2007 that led to the North American Monarch Butterfly Conservation Plan (Oberhauser et al., 2008). Increasing international interest in the North American monarch phenomenon also led to the designation on 8 July 2008 of the Monarch Butterfly Biosphere Reserve as a World Heritage Site (Anonymous, 2008). In this paper, we have presented an analysis of the long-term trend in monarch abundance, a decline that exists despite some fluctuation year-to-year. The combination of lowered numbers of fall migrants, the illegal logging in the overwintering region, the severe losses of breeding habitat due both to GM crops and development, and the near miss of catastrophic mortality by the 2010 storm suggest that better stewardship is needed to assure the future of the monarch migratory phenomenon.

# 2012 Monarchs Across Georgia Award Winners

## POLLINATOR HABITAT AWARD.....*Morgan County Middle School*

Monarchs Across Georgia recognizes Morgan County Middle School Outdoor Learning Center in Madison, Georgia as the winner of its annual Pollinator Habitat Award. The garden is used inclusively for all facets of seventh grade science. It contains host and nectar plants for a variety of butterfly species, as well as shelter, water, and basking sites. Sharon McCullough, a teacher at Morgan County Middle School shares that, "It has become a haven for pollinators in an area which was once devoid of the necessary habitat requirements." Furthermore, it has been an on-going progressive project receiving many grants, allowing them to extend the scope and include other subject areas, such as art.



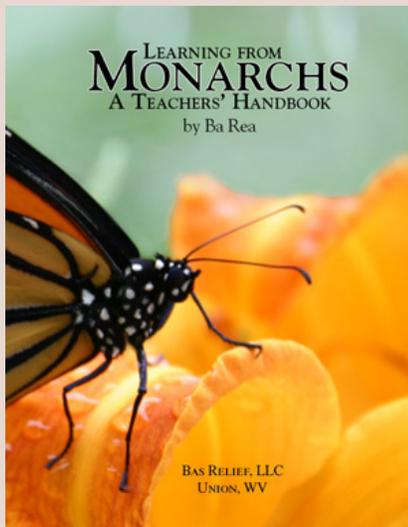
## SERVICE AWARD .....*Vicki Culbreth*



MAG is proud to announce Vicki Culbreth, Environmental Education Coordinator for the city of Roswell, as the recipient of the MAG 2012 Service Award. Vicki has coordinated all aspects of the newsletter for the past four years. She has donated her enormous talents in graphic design and editing to enable us to publish a stunning document twice a year. Vicki has worked hard for MAG as a workshop facilitator, Butterfly Symposium presenter, and pollinator garden developer. She is an amazing educator, reaching diverse groups of people such as seniors, students, and educators.

# 2012 Mexico Book Project

Due to your generous donations, we were able to provide more books for schoolchildren in Mexico, just in time for the holidays! Check out some of our favorite photos below:

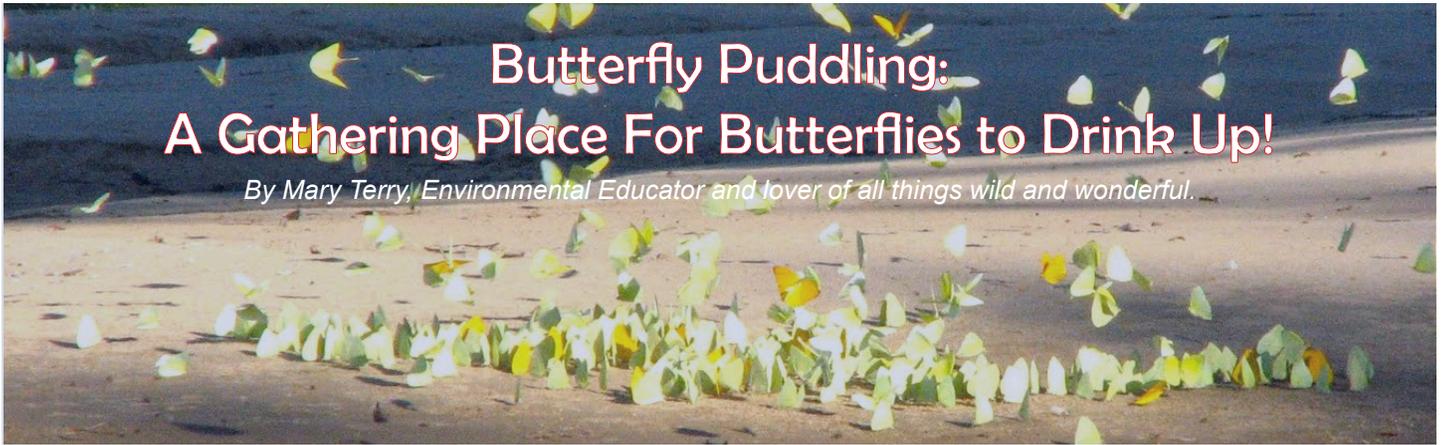


## Recommended Reading

[Monarchs] can be the focus of a profound inquiry science project, complete with math and graphing skills, which can connect students with an international community of citizen scientists. They can also be an exciting journaling theme, a catalyst for understanding geography and human culture, a dynamic study in ethics and a wonderful subject for art and design.

Created by Ba Rea, an educator and monarch enthusiast for 40 years, to accompany her annual monarch teachers' workshops, *Learning From Monarchs* is intended as a starting point for teachers interested in using monarchs in their classrooms. It introduces concepts and information that will be useful as you design your own monarch lessons.

~ From [www.basrelief.org](http://www.basrelief.org)



# Butterfly Puddling: A Gathering Place For Butterflies to Drink Up!

*By Mary Terry, Environmental Educator and lover of all things wild and wonderful.*

**S**pring is just around the corner and it is time to get butterfly gardens ready for lavish parties where cocktails are served all day! Just add puddling stations. It is very easy and greatly rewarding. Male butterflies in particular “belly up to the bar” to sip fermented fruits, minerals and salts to help them make sperm. It is also believed that this practice makes them more attractive to the females.

As a young farm girl growing up in North Carolina, I noticed butterflies gathered in shallow water puddles on dirt paths and roads. Huge gatherings happened right in our dirt driveway, about the time the pears dropped. As Daddy came home in the old Ford truck, the pears were crushed, and butterfly heaven was created. I started studying nature at an early age and never stopped. Today, I find that many of my childhood explorations taught me well. I just wish I had a better camera back then.

Which do you like better- watching butterflies or taking pictures? I love both! The benefits of adding puddles are many. When butterflies visit “the bar” they have a tendency to get a little friendly, and it is a prime time to take photos. The subjects are very mellow as you get close to them. Sometimes you can even touch their wings. If you have a good eye you may recognize that some of the males can’t get enough and will return daily. Tiger Swallowtails and Red-spotted Purple Butterflies love puddling.

## **How to Create Butterfly Puddling Sites**

1. Pick your vessel. It can be a plastic saucer or dish. Shallow ceramic or concrete planters also work well.
2. Survey your garden and yard for the best sites. You need a flat surface where you can sink your puddling vessel.
3. Add sand, river rocks, pebbles, and water. Leave some rocks projecting above the water.
4. You can also add a small pinch of salt, small amounts of compost or doggie poo (yes, they love dog poop!), or fermented fruit, which is a delicacy and loved by all (a little goes a long way).

As the saying goes, “build it and they will come”. I like to add several puddling sights to the garden and the yard. Other welcomed additions to the garden are warming rocks - flat rocks where the butterflies can rest while warming their wings. Be sure to include host plants and nectar plants. Add some shrubs and trees. It’s going to be a hot summer, and everyone will need a resting spot, some friends, and a sweet drink of their choosing. ✂

**Congratulations to our newly certified Pollinator Habitats!**

**North Point Garden Club & Smith Plantation, Roswell**

**Jenny Landrum & CT Walker Magnet School, Augusta**

**Morgan County Middle School Outdoor Learning Center, Madison**

## SPOTLIGHT... Plants For Your Pollinator Garden

### **Ruellia Ragin' Cajun (*Ruellia elegans* var. *Rajun' Cajun*)**

A tough little plant that's easy to grow and holds up well through heat and humidity. Grows 12-14" and blooms spring until fall. Full sun. Zone 7b – 11

This plant should be on everyone's wish list! At the UGA Trial Gardens it received a 4.79 out of 5 rating. Ruellia Ragin' Cajun™, part of the Athens Select™ program and recently included in the Southern Living™ Plant Collection, has also been named a FlameProof Award winner by the Dallas Arboretum Trial Program.

Native to South America, the plant is covered with brilliant scarlet flowers. Ragin' Cajun stays small at about 12 inches and is perfect for growing in a container. The flowers are held upright on thin stems that move with the slightest breeze. In north Georgia, Ragin Cajun' is a tender perennial or annual.

Ruellia is in the Acanthaceae family with members like the thunbergia, or black-eyed Susan vine. They thrive in moist, well-drained, organic-rich soils but perform well in poorer soils, too. They are also easy to propagate -- divide clumps, take root cuttings or plant by seed. Stems are easy to root in moist soil or sand. Another big plus is that they are disease and pest-free.

Ruellias, as a group, are plants that make everyone look like they have a green thumb and those red blooms attract butterflies and hummingbirds galore. Since Southern Living has included this plant in their collection, Ragin' Cajun should be readily available at your local garden center.



Virginia Brewer  
**Lavender Mountain**  
**HARDWARE**  
*and garden*

### **Species Profile: Ruby-throated Hummingbird (*Archilochus colubris*)**

Ruby-throated hummingbirds are found in North and Central America. They breed throughout the eastern United States and winter in southern Mexico, Central America, and in the West Indies. They are tiny birds, 7.5 to 9.0 cm long and weigh approximately 3.4 g (males) to 3.8 g (females). The back and head are iridescent green, the underparts are white. Males have a brilliant red metallic throat and a forked tail. Females have a dull grayish throat, and a square, white-tipped tail. Immature birds look similar to adult females, though young males may have a few red feathers on their throat.

Males return to the breeding area in the spring and establish a territory. When the females arrive, the males perform courtship displays. They begin by erecting their red throat feathers and harassing the female, flying in looping dives above her head. They do not establish breeding pairs; they separate after copulation and females provide all parental care. Nests are constructed of plant material, particularly thistle and dandelion, but spider webs, bud scales and pine resin may also be used. The outside of the nest is decorated with lichens. The female lays 1 to 3 (usually 2) eggs and incubates them for 10-14 days. The chicks leave the nest 18-22 days after hatching. The female continues to feed the chicks until they are 22-25 days old. Ruby-throated hummingbirds can raise up to three broods each year.

