

GENUS RUBUS

BY TOMMY NEWTON

SOME PEOPLE LOOK AT A BLACKBERRY BUSH AND SEE A TASTY FRUIT CROP. OTHERS SEE A NASTY INVASIVE WEED. DR. LAWRENCE ALICE SEES A LIFETIME OF RESEARCH OPPORTUNITIES.

Larry Alice, an associate professor in Western's Department of Biology, has been researching the systematics of the plant genus *Rubus*, which includes blackberries and raspberries, since beginning his doctoral work at the University of Maine in 1992.

"A lot of people ask me, 'How did you end up picking this group?' It's prickly. It's not a particularly nice plant. It's a weed. You don't necessarily get to go to scenic habitats to find them. You can look on the roadside or your backyard or a fence row," Dr. Alice said.

But for a botanist, the species are economically important, generally familiar, and biologically challenging. "It was something that I knew had so many problems that it effectively could be a lifetime worth of work," Alice said. "I didn't want a project that would get me a Ph.D. but then leave me wondering what I was going to work on after that."

In the past thirteen years, the work of Dr. Alice and his students has itself spread like a blackberry bush. The project has taken him from New England to southcentral Kentucky to various locations around the world and has opened the door for other research projects. On the Tree of Life,



Rubus indotibetanus, a large-fruited raspberry from the Mo Chu river valley in Bhutan.

where animals represent a branch and plants represent a branch, “somewhere on the little, tiny twig that I’m working on is where *Rubus* is and it’s on a larger branch that comprises the rose family,” he said.

Dr. Alice is seeking answers to what seems like a simple and fundamental question: What is a species in *Rubus* and how is it defined? But the genus *Rubus* is anything but simple. Depending on which classification you follow, historic or modern, the species

of *Rubus* number anywhere from 429 to 750 or up to 1,000 worldwide. “That’s a fundamental question,” Dr. Alice said. “Do we have 429? Do we have 750? How many actual species do we have? It’s difficult to say.”

For instance, in eastern North America’s array of blackberry species, “we currently recognize a confusing group of approximately twelve indigenous species, yet over 400 have been formally recognized,” he said. Determining how many species exist, where they are and where they came from is an important issue for fruit crop growers and breeders trying to increase their yields and product quality and for those areas or agencies trying to eradicate noxious weeds.

Dr. Alice and his students use a variety of DNA techniques to address the evolutionary biology questions of the genus *Rubus*. “What we’re looking at is this modern day pattern of biological diversity in terms of how many species there are, where do they occur worldwide, how have they gotten from one place to another over geologic time, and how did they come to be in North America? Did they originate here or did they originate in China?” he said. “We’re also looking at the historical processes that gave rise to the modern day patterns. So there’s that aspect of the processes that have generated the patterns that we observe today, and since they are historical they’re not something that you can necessarily go out and observe today.”

That means that Alice and his group have to make inferences or “educated guesses” about those historical processes because “nobody was there to observe what happened two million years ago.” The researchers studying such questions



Photo by LaDonna Harmon

Dr. Lawrence Alice

can use information from DNA, chromosome structure, cell structure, and biochemical data, and can examine the various morphological characteristics such as the size or shape of leaves, the color of flowers, the type of fruit, and the number of seeds.

The genus

Rubus is taxonomically challenging because of three phenomena that don’t occur in most plants.

***Rubus*: The botanical name for raspberry, blackberry, and other bramble fruits**

1. Hybridization. About seventy percent of all plant species may have incorporated some degree of hybridization in their history. The various species of *Rubus*, such as the blackberry and raspberry, are able to hybridize easily.

2. Apomixis. *Rubus* species can use asexual production of seeds to generate new plants. A hybrid derived from two species might not be able to produce seeds normally, but apomixis gives the plant the ability to reproduce.

3. Polyploidy or multiple sets of chromosomes. *Rubus* species can have the basic number of two sets of chromosomes or as many as thirteen



Photo by Dr. Lawrence Alice



***Rubus* growing on a roadside mountain in Bhutan.**

sets. Four, six, and eight sets are most common.

All of those factors have combined to create what Larry Alice calls a “hybrid swarm or a continuum of the species.”

As the *Rubus* species have hybridized over time, it has become more difficult to determine the original parental species. Two commonly

cultivated crops in the United States, the Loganberry and the Boysenberry, are both derived from crosses between the Pacific blackberry and the European red raspberry.

Hybridization has caused some of the problems with highly invasive weedy species in the Pacific Northwest and in South Africa. In the late 1800s, an American blackberry was intro-

duced as a fruit crop in South Africa but the species subsequently hybridized and has become a noxious weed that is impacting commercial forestry. In the Pacific Northwest, the U.S. Department of Agriculture is looking for ways to eradicate two European blackberry species or control their spread.

In February 2003, Dr. Alice and his students started work on a three-year, \$211,592 grant from the National Science Foundation. The group is hoping to sample and analyze twenty percent of the approximately 750 *Rubus* species worldwide. “The sample that we’re looking at of twenty percent of the total species of *Rubus* worldwide will be sufficient to answer this initial phase of questions,” he said.

They’ve acquired samples from the United States, China, and Bhutan, and will be collecting in Ecuador and Mexico next summer. “We’re trying to understand the evolutionary relationships and provide a road map of what’s related to what,” Dr. Alice said.

The trip to Bhutan in May 2004 was noteworthy because the Buddhist nation in the Himalayan region is biologically pristine, is largely unexplored, and allows just a few thousand foreign visitors each year. During a seventeen-day visit, Dr. Alice and Brittany Sutherland, a May 2005 graduate from Lawrenceburg, traveled across the mountains and valleys of Bhutan and collected specimens of twenty-five different *Rubus* species.

Sutherland is one of several students who have assisted Dr. Alice during his six years thus far at Western. Sutherland will be working on her doctorate at Washington University in St. Louis while another recent graduate, Kate Hertweck, is attending the University of Missouri for doctoral work. One of Dr. Alice’s first WKU students, Amber Hogart, is completing her doctoral research at the University of California-Davis.

By visiting other countries and presenting research papers at major conferences, the students exemplify Western's "theme of engaging students and giving them opportunities to experience real science," Dr. Alice said. On trips to Bhutan or Alaska or other locations, Dr. Alice schedules activities to provide the students with opportunities to learn about the biological diversity, geology, culture and history of the places they visit. After a conference in 2004, Dr. Alice and three undergraduate

the number of species, their correct scientific names, morphological descriptions, and accurate distribution maps for all species of *Rubus* in North America including Greenland. During the summer, he spent three weeks at eight institutions in California to study the *Rubus* specimens there and tracking the spread of two invasive European blackberry species.

As curator of the WKU herbarium, Dr. Alice gets requests for information about the spread of invasive plants, such as kudzu, that may have

"The more knowledgeable I can become on a global basis on these species of Rubus the more types of projects I can get involved in."

students visited nine national parks in the southwest, including the Grand Canyon and Mesa Verde.

In 2005, Dr. Alice also began a project on the classification of the genus *Rubus* for the Flora of North America, which hasn't been done since 1913. The work will include

been introduced as groundcover or as flowers in a yard. "A lot of times it becomes too late before we see it as a problem," he said. "The more knowledgeable I can become on a global basis on these species of *Rubus* the more types of projects I can get involved in." He is hoping his research



Photo by Dr. Lawrence Alice

Rubus bloom.

on the genus *Rubus* as well as the mint and rose families along with his other projects will help him create a legacy at Western.

"If you're only going to do the Flora of North America once every one hundred years, it's a great opportunity for me," he said. "I think it's a good opportunity for Western and the Department of Biology to have that credit as an author. To a large degree, comprehensive universities like ours aren't necessarily the ones involved in these types of projects. They tend to be the bigger institutions like Cal-Berkeley or Cornell."

Dr. Alice, who received his bachelor's and master's degrees in botany from Southern Illinois University at Carbondale, also has benefited from the trips by making national and international research contacts. The trip to Bhutan, for example, provided him with additional contacts at the Royal Botanic Garden in Edinburgh, Scotland, and at the Missouri Botanical Garden.

Alice opted for a position at WKU because "by spending my entire professional career at Western, all my specimens end up being deposited in our herbarium, and all the publications we do carry Western's name." Dr. Alice also is developing an international reputation in the field. He doesn't like to apply the term "expert" to himself, but he admits that he is considered by his peers to be the most knowledgeable person about *Rubus* on a global basis.



Photo by Dr. Lawrence Alice

Rubus ellipticus, another raspberry found throughout Bhutan and Asia; introduced in other countries for fruit production.