TCS Sponsors Cycad Expedition to China

Introduction by William Tang, Miami, FL

A cycad expedition to China, made possible through funding provided in part by the Cycad Society (TCS) and A&A Cycads, was conducted in May 2008. The trip was hosted by Professor Liu Nian and Zhongkai University of Agriculture and Technology in Guangzhou, China. Professor Liu, Anders Lindström, and I have been developing the *Cycas debaoensis* Conservation Project in China over the last nine years (see Tang, 2006). Through steady work with local villagers, teachers, forestry officials, and other authorities in the region, this project has achieved a successful level of protection for this rare cycad species and has provided a model for cycad conservation that is now attracting attention from many parts of Chinese society. This expedition provided the first opportunity to present the project first-hand to people from the outside world. It was also a rare opportunity for experts from other countries to give input and advice on Chinese conservation issues to Chinese cycad researchers.

Expedition members were volunteers who paid their own way to China and had to cover much of their own lodging, food, and travel expenses while in country. The expedition had several ambitious goals. The first was to develop the educational aspect of the *Cycas debaoensis* Conservation Project. Over the years it has become increasingly clear to Professor Liu, Anders, and me that education is the most important facet of conservation. During this expedition, we hoped to expand beyond school construction activities and help develop cycad awareness through donations of books, educational software, and computer equipment for the teachers and students of the valley where this cycad occurs. Each expedition member brought different expertise. Members skilled at identifying birds, reptiles, amphibians, insects, and mollusks were tasked with conducting a faunal and photographic survey of the cycad habitat. Also, specialists in plant identification, GPS mapping, and languages contributed. The goal was to gather ecological information from the entire cycad habitat for an educational website. This website would benefit students from the valley and

Fig. 1. Part of the opening ceremony of the cycad symposium at Zhongkai University; at the far left are Liu Nian, Tim Gregory, and Ding Yue Wang; center is Chen Chia-Jui; and far right are Willie Tang, Jeff Chemnick, and Li Nan (photo by Nick Wu).

Fig. 2. Cycas taiwaniana *cultivated at the Dinghushan Buddhist Monastery (photo by Nick Wu).*

Fig. 3. Michael Calonje and Rita Singh with Cycas elongata *and dinosaurs at Qing Xiu Mountain Scenic Resort in Nanning.*

Fig. 4. Three Cycas sexsemnifera *plants on a cliff face near Nanning (photo by Nick Wu).*

Fig. 5. Expedition members Limei Tang and Michael Colonje view Cycas ferruginea *in habitat.*

Fig. 6. Expedition members presenting gifts to students and teachers of the Debao Cycad School (photo by Nick Wu).

around the world who want to learn about conservation of entire cycad ecosystems, including plants and animals that share the living space with the endangered cycad.

A second goal was to build better communication between Chinese cycad researchers who are involved in conservation with their counterparts in other countries. China is a country emerging from a long period of isolation. Language barriers and meager opportunities for travel isolate many conservation workers in China from the latest advances in effective cycad conservation. Fortunately, the ten expedition members included six members of the IUCN Cycad Specialist Group, many of whom are conducting cycad conservation projects in India, Thailand, Guam, Mexico, and other regions.

A third goal was for expedition members to view other Chinese cycad species in habitat. They could then form a broader assessment of the conservation status of cycads in China and make recommendations for improvements.

The expedition commenced in style at Zhongkai University in the southern Chinese city of Guangzhou. Our hotel rooms had magnificent views of the Pearl River. Participants, including many of the top cycad researchers from China, were given a lavish welcome ceremony and banquet (Fig. 1). This cycad symposium was the first international meeting held at the university; the university president along with various deans and vice-presidents greeted expedition members. Over two days of presentations, cycad researchers and students discussed a broad range of research and conservation ideas.

Next, the expedition members, Professor Liu, and several graduate students began a bus tour of the Chinese countryside, starting with the Dinghushan Nature Reserve, some 40 km outside of Guangzhou. One of the last intact pieces of lowland subtropical forest in southern China, this reserve is designated by the United Nations as a UNESCO World Heritage Site. Here the expedition members could begin their faunal and floral surveys. We were told by managers of the reserve that a small stand of wild cycads was recently discovered in the steep terrain of this protected forest, and this reserve may be one of the last wild habitats of *Cycas taiwaniana* left in China. We viewed the cultivated specimens of this species in the Buddhist monastery at Dinghushan (Fig. 2). Buddhist monasteries and the land surrounding them are often sacred places in China, and in this

case the monastery provided the nucleus of the reserve when it was formed in the 1950s.

Next we headed for the city of Nanning in Guangxi Province. Guangxi borders the country of Vietnam and is dominated by a karst topography of limestone mountains. The abundance of steep, rocky slopes in this region makes it an ideal habitat for cycads, and over ten species have been described from Guangxi and adjoining regions. Upon arrival in Nanning at dusk, we viewed a surreal skyline of cranes and half-built skyscrapers – a testament to the rapid pace of development in this part of the country. Our hotel abutted the Guangxi Forestry Department, our official hosts on this part of our expedition. The next day, in pouring rain, expedition members visited the cycad garden of Qing Xiu Mountain Scenic Resort. This garden has amassed a large collection of cycads from Guangxi province as well as many specimens of *Cycas elongata* from southern Vietnam (Fig. 3). *Cycas elongata* is exported from Vietnam into China in large numbers for the landscape trade (see Osborne & Nguyen, 2002; Osborne *et al.*, 2007). Since Nanning is along the main trade route between Vietnam and China, most of these plants pass through this city before entering commerce in China. The managers of the resort explained that they purchased several of these shipments believing that they were much more able to care for them than commercial dealers, who were only interested in selling them for profit and had little knowledge about how to care for them.
In the afternoon our group attended their second symposium, at the Forestry Dept. of Guangxi, where we gave PowerPoint presentations on the *Cycas debaoensis* project and on cycads in India and Mexico. We were surprised and delighted to learn that Professor Yue from the Guangxi Normal University had embraced the *Cycas debaoensis* project, and he and many teacher trainees had embarked on an outreach program with teachers and students near the habitat of this species.

The next day we had the honor to be guided by Professor Y.C. Zhong, retired official from the Guangxi Forestry Department. Professor Zhong has spent his career exploring the mountainous terrain of Guangxi for cycads and describing them. He guided us to a population he recently discovered near the Nanning airport. Through some deft rock climbing and observation through a telescope we saw numerous plants of a species

Fig. 7. Female cone on a cultivated plant of Cycas *sp. (possibly* C. segmentifida*) growing next to its original habitat (photo by Nick Wu).*

Fig. 8. Irene Terry collects cone fragrances from Cycas debaoensis *as village children watch.*

we believed to be *Cycas sexseminifera* (Fig. 4).

Our official obligations to the Forestry officials of Guangxi Province fulfilled, we embarked on the most interesting phase of the expedition: the exploration of the mountainous hinterland. Our first bus stop was the village of Long Tie, where we were able to climb up to a cliff population of *Cycas ferruginea*. The rachis and undersides of the leaves of this species are covered with red tomentum. The tomentum and the stiff curved leaflets make this a particularly ornamental species (Fig. 5). After another sumptuous banquet with local officials we arrived at the city of Debao, government seat for Debao county. Due to the construction of an enormous bauxite processing center nearby, this town has doubled in population since we first started our conservation project nine years ago.

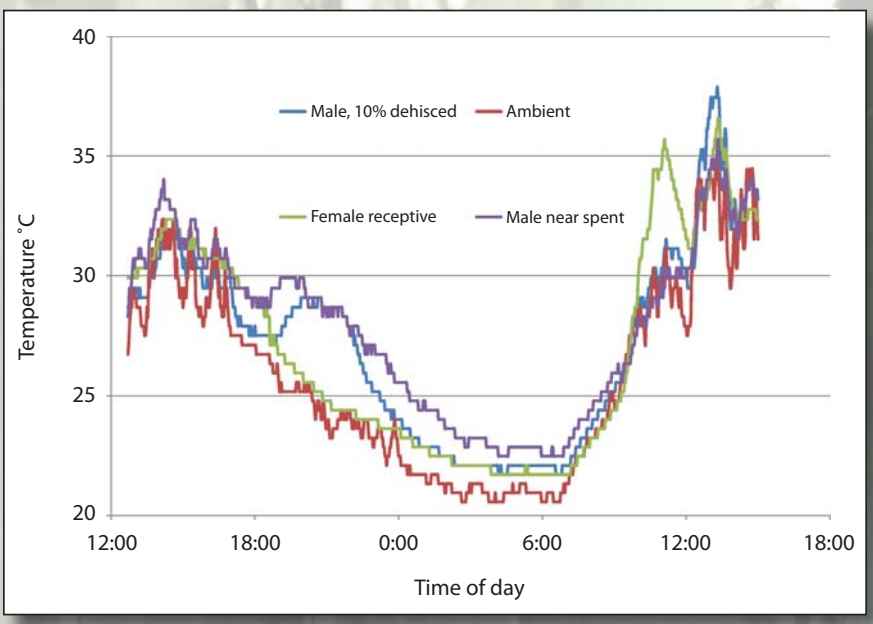

Fig. 9. Temperature of two males—one nearly spent, and one just beginning to dehisce—and one receptive female cone of Cycas debaoensis *in situ. No covers were over cones, thus some cones may have heated during the day due to solar radiation.*

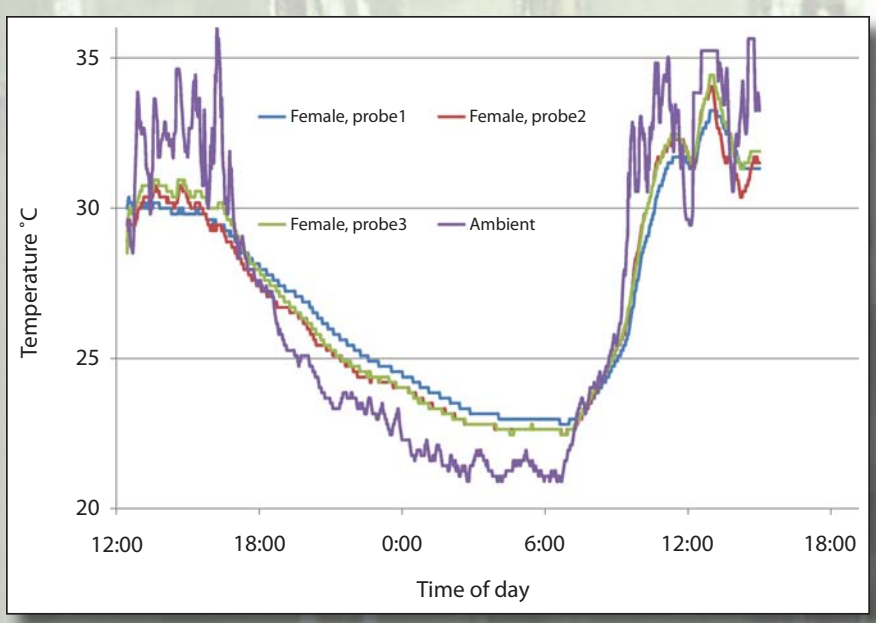

Fig. 10. Temperature of a female Cycas debaoensis *cone with three probes versus ambient temperature.*

Our next three days were spent shuttling back and forth from our hotel to the site of our conservation project on *Cycas debaoensis* near the village of Fuping. On our first day we visited the classrooms of the Debao Cycad School, named in honor of the local cycad. We introduced ourselves to the students and passed out pencils in a gesture of goodwill and friendship. Then the expedition spent the afternoon exploring the *C. debaoensis* population and the conservation nursery in preparation for survey work and other experiments the next day. In the morning we visited the school once again for the official ceremony. The entire school trouped out into the playground as expedition members took turns making speeches and presenting the gifts of two computers, a printer, a variety of software and books for the school library (Fig. 6). In addition we made a cash contribution to the valley authority for improvements to the school, road, and other infrastructure associated with the conservation project. Over the last nine years the project managers have made numerous visits to the valley and one of the students of the school (which serves children up to 12 years old) remarked that she recalled our visits as far back as she could remember. It dawned on me that after years of difficult challenges and effort, perhaps the project had finally become established in the minds and culture of the local people. Indeed, for the children, protection of the cycad had become the "normal" and only view of a plant that was once merely seen as a weed. This change in view was accomplished with a relatively small amount of funding, collected from individuals in the international cycad community and from plant societies like TCS. More important than money, perhaps, has been the international attention the villagers have received. Once a remote valley virtually unknown outside of the county, the people now had pride that they were known throughout China, and indeed the world, for possessing this special plant and for the efforts they have taken to protect it.

The expedition members spent the next day and a half in the grueling sun resurveying the population. The population was first surveyed in 2001, and on this trip we wanted to assess change or decline in the population to gauge how successful the conservation project had been. We used the latest GPS technology to produce highly accurate maps of the population and the terrain. The production of this map can serve as the basis for future research and conservation at the site.

Before we left Guangxi, we had the chance to observe one more wild cycad population, not far from that of *Cycas de-*

baoensis. We believed this long-leafed species to belong to the *Cycas segmentifida* group, an inhabitant of the forest understory (Fig. 7). We viewed plants, however, only on cliffs and steep slopes – places where agricultural activities had not yet cleared them. We left Guangxi with the impression that four or more cycad species formed a mosaic of scattered populations in this rugged limestone mountain range. Perhaps the climatic shifts associated with the glaciations of the last two million years have shuffled the cycad species of the region back and forth through the limestone valleys as climate zones crept back and forth between north and south.

All in all, the expedition members had a great time seeing China close up and contributing to the *Cycas debaoensis* Conservation Project. In the sections that follow, other expedition members describe their experiences and contributions to the project. Personally, this trip was the most satisfying of all my travels. I want to thank TCS for making it possible and all the expedition members who gave of their time and expertise to make it so interesting and enjoyable.

Comments by Tim Gregory, University of California Botanical Garden

There is very little that I can add to what Willie has already said except to thank Willie's charming wife Limei, who served as our translator, tour guide, and cultural attaché. She contributed as much as anyone to the success of the trip.

I was invited as a member of the IUCN Cycad Specialist Group and because of my involvement in various cycad conservation projects in Mexico and with South African cycads in cultivation. This was an amazing trip to one of the most remarkable places on the planet. The *Cycas debaoensis* project is also, in my opinion, one of the most successful cycad conservation projects in the world and serves as a great example of what can be accomplished with minimal funding if care is taken to fully engage the local people, relevant government authorities, and local scientists. Willie, Anders, and Professor Liu deserve great accolades for making this happen. They have successfully educated all these parties to make them aware of the cycad treasure they have and enlisted them together to protect this population. I have seen a similar effect in Mexico where simply making the local people aware that the plants on their land are **not** found everywhere else in the world instills a new sense of pride and stewardship that changes the way they make decisions about habitat destruction and commercial collection. This project has gone two steps farther, though, in that the county, provincial, and national government authorities, as well as research scientists, have also become full partners and key players in the preservation program. This is becoming a model for other cycad and plant preservation projects in China and a source of national pride. As foreign advisors, I think we served to validate their success to them.

I also had an opportunity to visit Dr. Li Nan and her colleagues at the national cycad collection at the Fairy Lake Botanical Garden in Shenzen. This is truly a stunning collection of not only cycads, but petrified wood, other fossils, and other Chinese plants, as well as an up-and-coming research institute. There is a large amount of new cycad biology and genetic research being conducted there that we all look forward to hearing about in the future. As many of you know, the 9th International Conference on Cycad Biology will be held at the Fairy Lake Garden in 2011, and I strongly recommend that anyone interested in cycad biology not miss this opportunity to see this garden and travel around to see the cycad treasures of China.

Comments by Irene Terry, University of Utah

At the end of May, I joined a group of cycad specialists on a magical journey to some remote areas of China to participate in a conservation program of a native endangered cycad, *Cycas debaoensis*. The specific objective of this particular journey was to survey/census the current native cycad plants near the village, to contribute computers and school supplies to the children of the Debao Cycad School (serving the valley where this cycad is found), to interact with the villagers in the village next to the wild population, and to gather scientific data on *C. debaoensis* and the other biota of its habitat.

I arrived during the latter part of the trip and was able to see some of the local cycad populations near Nanning before heading to help with the survey and visit with the children of the school and village. My objective was to gather data on thermogenesis of male and female cones of this species and to try to obtain cone volatiles from male and female cones. This would be a first step in understanding the pollination process, as both thermogenesis and volatiles are known to be important signals in mediating behavior of the specialist pollinators. Insects have already been sampled from cones of these cycads, so next it is important to know what cone traits affect their behavior. Thermistor temperature probes (HOBO, Onset Computer Co., Inc.) were inserted into male and female cones located in the *Cycas debaoensis* garden and were left in place for almost 28 hours. These temperatures were compared with the local ambient temperatures. Some observations of

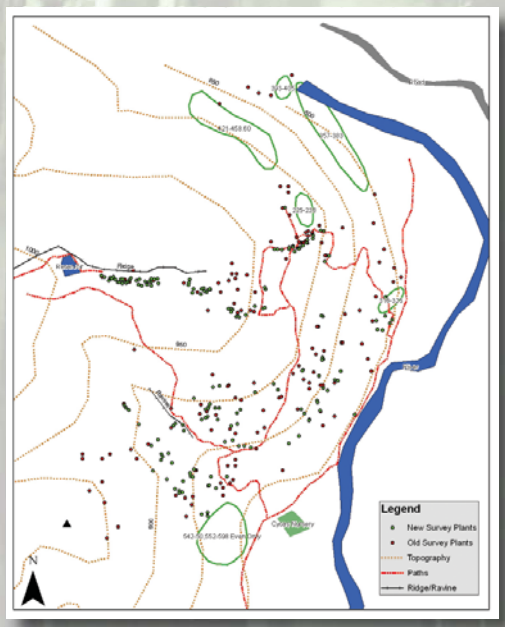

Fig. 11. Map of the Cycas debaoensis *population produced during this expedition.*

insects were made during the late afternoon and early after sunset.

We also extracted volatiles using methods previously described. Plastic cooking bags were placed over either a male or female cone, a Pasteur pipette loaded with Porapak Q was inserted into the bag, and air and volatiles were withdrawn from the bag through the tube by a battery powered pump @ 100 ml per min. for 30 min. (see Fig. 8). This was done on two different male and female cones, at two times of day.

Results: Thermogenesis and Insects Observations

Two cones, loaded with beetles, were observed during the late afternoon. We observed that insects were very active, moving throughout the cone, coming to the surface, and then going back inside the cone. This was during daylight hours. In the evening after sunset, we observed some beetles moving around the outside of cones. We also observed beetles inside one of the female cones.

Below are temperature profiles of two male and two female cones (Figs. 9, 10). Ambient temperatures ranged from 22 C just before sunrise to 32 C and 35 C during the afternoons of 23 and 24 May. The male cones exhibit a thermogenic pattern that is typical of many beetle-pollinated cycads, where there is a metabolic burst occurring during the late afternoon, resulting in cones increasing in temperature to 3-5 C above the ambient, but not greater than the maximum ambient of the day. This is not residual heat from the day time heating, but rather a burst of temperature resulting from increased metabolic activity. Female cones showed no significant signs of thermogenesis, but they appear to have slight metabolism overnight. The receptive female cone in Fig. 9 has a high temperature during the late morning, but this may be from solar radiation. More cones need to be tested over several days and under covered conditions.

Chemical volatiles were very weak quantitatively, so it is difficult to determine the chemical composition. A more sensitive method such as thermal desorption or a longer sampling time is likely required to get adequate quantities of volatiles to analyze.

Comments by Michael Calonje, Montgomery Botanical Center (MBC), Coral Gables, FL

My role in the *Cycas debaoensis* research trip was to lead the mapping of the population at the type locality. This population had previously been mapped in 2001, but the map needed to be updated with more geographic features and more precise locations for the plants. Using ArcGIS software generously granted to MBC from ESRI, the original map was re-digitized and new, more detailed biogeographic data were added (see Fig. 11). Using GIS technology to map this cycad population will assist Debao forestry officials in monitoring this population and to monitor changes in the population over time.

Every additional survey adds valuable information to the dataset. For example, because many *Cycas debaoensis* have subterranean stems and may not have any leaves at a particular point in time, each survey has uncovered additional plants that were missed before. It is also interesting to note that surveys conducted at different times of the year have important advantages and disadvantages. Plants are easiest to find during the winter, as the tall grasses that hide many of the cycads in the summer die out, making the plants easier to find. However, conducting the survey in the spring as we did is very useful as it is the primary reproductive season for *C. debaoensis*, and many plants can be found with male and female cones (see Fig. 12).

Interestingly, the cumulative sex ratio observed over three seasons of observation is close to two males for every female. One of the main reasons why this gender disparity is thought to have occurred is that a large proportion of the population was poached from the mountain soon after its discovery, and female plants were specifically targeted for potential seed production in cultivation.

The mapping of this population is a critical tool in understanding the health of the population and the threats facing it. Having a number of cycad researchers study the population also emphasizes the importance of the cycads to the local villagers, increasing the likelihood that this population will continue to be protected in the long term.

Fig. 12. Satie Aramie, amphibian specialist, takes GPS readings for a wild coning male Cycas debaoensis *during the population survey (photo by Nick Wu).*

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