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Multi-discipline and multi-grade lessons in the study of *Dactylopius* (Homoptera: Coccoidea: Dactylopiidae)

Abstract - The *Dactylopius* (cochineal) insect has been used as a source of red dye for over three thousand years, however there is limited public knowledge of it. As entomologists leave the profession, the need for new entomologists increases, especially in light of the continuing shortage of professionals. To bridge that gap, educational activities that attract, inspire, and encourage people, especially young students, are discussed. Included are cross-curricular cochineal activities that involve multi-level students, in both the classroom and community.

Key words: *Opuntia,* cochineal, carminic acid, education, publishing.

INTRODUCTION

Historically, cochineal was used in the production of textiles in Mesoamerica (Klein, 1997; Rowley, 1997; Rodríguez, Méndez & Niemeyer, 2001; Donnan, 2001, personal communication) and later in Europe, Asia, and North America (Nobel, 1994; Halpine, 1996; Sandberg, 1997). The dried, female insects, and the dye principle, carminic acid (Lillie, 1977), became an important international commodity (Sandberg, 1997). The host plants, the *Opuntia* cacti (Donnan & McClellan, 1999), were transported to South America, the Canary Islands, Java, India, Portugal, and other parts of the world for the cultivation and breeding of the scale insect (Perez Guerra & Kosztarab, 1992; Nobel, 1994; Sandberg, 1997; Böhmer, 2000). The insect was used as a biological stain (Lillie, 1977), and is currently used throughout the world by the food, cosmetics, artists' pigment, and a limited number of textiles industries (Böhmer, 2000; Colores Naturales de Chile and COLCA APX web sites; Schweppe & Roosen-Runge, 1986; Halpine, 1996; Turok, 1996).

With this historical background, it appears that there is a general lack of knowledge about the cochineal scale insect. Additionally, when people write about the cochineal it has been misrepresented to be a beetle (Macdonald, 1998; Spilker, 2001) or a worm (Turok, 1996). This lack of awareness and knowledge is compounded by the fact that there is a longstanding, serious, and world-wide shortage of entomologists, due to the

fact that a limited number of people are entering the profession, and others are leaving through attrition, death, or by taking administrative positions (Kosztarab, 1990; Kosztarab, 2001, personal communication). The identification, research, biological, and ecological work, just to name a few of the fields of study, will go undone throughout the world until people start entering the fields of entomology and coccidology.

This shortage of specialists may be addressed through opportunities for young people to experience the unique, aesthetic, challenging, and scientific work of an entomologist, or more specifically, a coccidologist. While there may seem to be a lack of public interest in entomology, I suggest that people do want to know. In the words of a 17-year young man who was involved in the cochineal project, "It's fun when you learn something you don't know."

CLASSROOM LESSONS AND COMMUNITY LEARNING ACTIVITIES

Students in several elementary and secondary schools in south-western United States had an opportunity to study the cochineal insect by using a multi-discipline approach. The activities were based in such areas as: world history, science, art, journalism, Internet research, desktop publishing, and oral communications, while fundraising and community outreach components were included.

The cochineal project began with a discussion about the historical uses of the scarlet color from the cochineal scale insect and its host plant, both believed to be indigenous to Mesoamerica. The Aztec or Mexica leader, Montezuma II (also known as Moctezuma or Motecuhzoma), later the Spanish Catholic Cardinals, the British military "Redcoats," the Vatican Swiss Guards, and a number of Catholic Popes, at one time or another, may have wore garments dyed with this insect. To meet the growing needs for the superior color and the profit motive, the insect and cacti were shipped and grown throughout selected areas in the world (Sandberg, 1997). Upon hearing this historical information the students, excitedly demanded to see the insects. The sticky, white fuzzy patches on the *Opuntia* cacti, were at first cautiously smashed with a finger and then the students joyfully finger-painted with the scarlet coloured carminic acid. Students also observed the specimens through magnifying lens and stereomicroscopes. They sketched what they saw, invited others to see what they observed, and focused their attention not only on the cochineal insects but on other insects as well, often running outside the room to collect more specimens. In numerous cases, students, school district employees, friends and acquaintances brought cochineal covered cactus pads to school. Requests for public assistance were heeded and cochineal related objects came forth. Students experimented with imported, dried cochineal, admired a small cochineal-dyed rug from Oaxaca, Mexico, examined tubes of fine artists' paints, and read the labels of bottled drinks credited with containing 'cochineal extract and carmine (color).'

Several cacti hobbyists visited the school and discussed not only the cacti but also

the insects on the plants. In addition to the presentations many students received a cactus, drew several views of their plant, learned how to frame their art, and submitted it for juried cacti and succulent shows. The art of illustration took two other forms when students created their own children's storybook and a cartoon strip, both with anthropomorphized female and male cochineal as superheroes, enemies, victims, lovers, husbands, and wives. Next, student writings were not only scientific, poetic, but thought provoking as well. The bugs became the subjects of stories with a moral and fairy tales that expressed questionable, dating practices. Other types of writings included essays on historical cochineal trade routes, reports on interviews with guest speakers and mentors, poetry in the voice of the insect, and press releases.

Another creative writing project included the publication of a student-edited booklet with writings and illustrations. "The Golden Bug: The Story of the Red Cochineal," containing 50 pages, includes scientific and historical research, black and white photographs, drawings, poetry, bibliography, web sites, a cartoon strip, and comments by both elementary and secondary school students. Donations from book sales have grown to $1,000 in three years, with all the money being given back to the students, while an additional $800 has been received from grants and awards. The money helped to publish, promote, and purchase needed materials for the cochineal related activities. Public speaking skills were improved as students discussed their Internet research, read drafts of their stories, and performed an original, cochineal-based, one-act play. They discussed their preliminary press releases and rehearsed pending conversations with media representatives. Students also created a press conference that was attended by 'guest' classmates, and three, community media professionals. Additionally, students conducted a seminar in which they enthusiastically taught their cochineal knowledge to invited 'guest' students. The cochineal project enlarged when the student cochineal displays were featured at locations such as cacti and succulent events, school district meetings, a book signing event, university teacher-training courses, and a clothes designers, wearable art guild meeting. Furthermore, when the projects of the teenagers were taken to a class of nine and ten year old students, both questions and compliments came forth in the form of letters, and in some cases with drawings that included cochineal the children obtained from home.

CONCLUSION

The results of this *Dactylopius* (cochineal) project have included an increased knowledge and greater appreciation of the scale insect and entomology. Students demonstrated their knowledge through a wide range of disciplines and were recognized by peers, faculty, family, and the public. Students have not only been the pupils but become entomologists-in-training. They self-published a well-praised book and donations have been regularly awarded back to the students. These activities have resulted in an appreciation for insects and may help students consider entomology as a hobby or profession. The last and most rewarding outcome of this cochineal project

and equally capable of happening in other communities, is the fact that the students enjoyed learning about something unique and they gained an incredible sense of pride and confidence. The use of these activities may help bridge the gap between not having enough entomologists and an inexhaustible number of naturally, curious students.

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