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An appreciation for the natural world through collecting, owning and observing insects

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INTRODUCTION

Insect collecting has served as a central part of a naturalist's lifestyle for centuries. Some of the greatest scientists engaged themselves in the joys of insect collecting and observation, which often began at a young age. Charles Darwin regularly went to the coast of Wales, and to Wicken Fen near Cambridge, to hunt for beetles that he prized (Barlow 1958). Gregor Mendel, pioneer of modern genetics, enjoyed beekeeping (Večerek 1965). Theodosius Dobzhansky, a central figure in evolutionary biology, became a biologist after collecting butterflies during grade school (Alaya 1985). Alexander von Humboldt, considered the father of biogeography, collected insects during his formative years in Germany (De Terra 1955). Edward O. Wilson, one of the strongest voices in the conservation of biological diversity, credits his career to the ants he observed as a boy in Florida (Wilson 1994). One wonders whether these renowned biologists would have developed their ideas if it weren't for their interest in collecting, owning, and observing insects during their childhood.

Insect collecting can be remarkably enjoyable and brings together the excitement of exploration with learning. Every entomologist, both professional and amateur, knows the joy of capturing a prized bug in a butterfly net. This act often captivates the netters themselves, leading them into the study of insects for the rest of their lives. Charles Darwin wrote in his autobiography, 'No pursuit at

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Cambridge was followed with nearly so much eagerness or gave me so much pleasure as collecting beetles. It was the mere passion for collecting…' (Barlow 1958: 20). Another famous Cantabrian, Vladimir Nabokov, later put it this way: 'Few things have I known in the way of emotion or appetite, ambition or achievement, that could surpass in richness and strength the excitement of entomological exploration' (Nabokov 1966: 126).

The joy of collecting, owning observing insects also often leads to discoveries that can serve as important contributions to science. Insects constitute approximately 58–67% of the total diversity of all eukaryotic species in the world (Alder and Foottit 2009), and the number of individual insects on the planet at any given moment is thought to be a quintillion (Williams 1964). Human benefits from invertebrates include nutrient cycling, plant pollination and propagation, maintenance of plant community composition and structure, food for insectivorous vertebrates and maintenance of animal community structure (Gullan and Cranston 2010). However, the number of insect taxonomists does not correlate with the number of insects on the planet. Only ~19% of US taxonomists work on insects while 26% work on vertebrates and 30% study plants (Gaston and May 1992). Herbert Ross once wrote, 'One thing [that should] never worry the entomologist[:] … running out of work. There is so much to be done and so many fields in which the surface has merely been scratched' (Ross 1945: 248) – which remains the case to this day.

Unfortunately, humans are increasingly becoming distanced from nature and the outdoors. Children, who are innately curious about nature, are now frequently confined to their homes and sit in front of a flat screen. Parents are also going outdoors less than they used to, and it is not rare to meet adults in urban settings that have never gone hiking (Louv 2005, 2011). Cities continue to grow, and the open lot that was once a sanctuary for migratory birds may now be replaced by a shopping mall, the stream nearby that was once a haven for fish, frogs and dragonflies may now just be a concrete trench. While we can still find plants breaking through pavement, dragonflies defending territory over parking lots, butterfly gardens in people's yards, the natural environment that once existed is rapidly diminishing. How can we inspire natural history education when the global landscape is changing so rapidly? Not only do we need to advance natural history education in schools, but we also need to recapture the excitement for nature that is innately within us, according to E. O. Wilson's hypothesis of Biophilia (Wilson 1984). We will need to explore the outdoors,

and an obvious place to begin is to provide butterfly nets so that children can collect, rear and observe insects.

THE BUTTERFLY NET

The butterfly net is an extremely valuable and versatile tool that can capture one's interest in natural history and has the potential to harness great interest for the natural world. It is one of the simplest and most important tools a child or adult can have, and has been used since Victorian naturalists travelled across the world. As the second author put it in an essay on the subject, 'Kids love nets because chasing insects is fun. It also brings the chaser face-to-face with exciting, novel, always-surprising life. Talk to any number of biologists, doctors, wildlife managers, and other life-science professionals, and the preponderance of them will tell you that catching bugs was a vital early stimulus for their engagement with nature' (Pyle 2009: 17). Insect nets also have the virtue of being inexpensive, or even easily constructed by kids from available materials.

Many of us who do not frequently interact with nature can immediately become interested in wildlife through the simple joy of collecting. Two of the first author's personal experiences immediately come to mind. The following are told in the first person, from the primary author's perspective.

In high school, I went on a 4-day holiday trip to Jamaica with a close neighbour, Owen, and his father, neither of whom had collected insects with a butterfly net. Following my habit of carrying my butterfly net everywhere, I packed two collapsible nets for the trip. We stayed in a large resort hotel in Ocho Rios, and on the morning after our arrival, we decided to go to the beach to swim. Owen immediately jumped in the water but I decided not to go in because I never was a great swimmer. As I pondered whether to go into the water, I noticed several white butterflies flying around bushes along the shoreline and contemplated returning to my room to get my net. But as an adolescent 17-year-old, I guess I did not want to be seen with a butterfly net on a beach full of young women. I pretended to walk on the beach as a tourist, but my eyes were fixed on the butterflies. They flew from side to side across patches of vegetation, occasionally landing and spreading their wings as they rested on leaves. The species was the white peacock, *Anartia jatrophae* L., a common Neotropical lowland butterfly that I had never seen before. I couldn't hold back anymore. Like a programmed robot with a chip inserted during childhood, I ran back to

the hotel room to get the rusty collapsible butterfly nets at the bottom of my suitcase.

Sunbathers by the hotel pool lifted their sunglasses as they watched a skinny, shirtless teenager run along the edge with a butterfly net in each hand. When I reached the beach, Owen was nowhere to be seen, but his dad was sitting on a tree stump smoking a cigarette. I rested a spare net by the stump and started chasing the butterflies with the other. Without even asking, Owen's father joined soon after I began. He too began running on the sand barefooted, and together we chased the butterflies, the weight of our bodies sinking into the sand as we ran. He caught one, then two, and many followed. Because I hadn't taught him anything about what to do after netting a butterfly, he took one net, caught one, then switched nets with me, and caught another. While I was examining each butterfly he collected in my hand and noting details about them, I had a few moments to glance up to see how he was doing. What I saw was a middle-aged man running up and down the beach with a butterfly net without the time to flick the ashes off his cigarette in his mouth. He still mentions the excitement he felt chasing those butterflies that day.

Years later, I had a similar experience with another friend who had never previously collected insects. In 1999, I took a year off from college and lived in Japan. During that year, I had the opportunity to search for *Luehdorfia japonica* Leech, or 'Gifu-cho' in Japanese, one of the most spectacular swallowtail butterflies in Japan. The butterfly is somewhat challenging to find as it only flies for about a week in the spring and has a restricted habitat. I knew of a good locality in Toyama, about 8 hours away from my home by car. Because it was so far, I decided to ask my 35-year-old businessman friend, Sada, to help with driving. We left around 9 pm, and arrived the following morning around 5 am in Toyama at a hill with a small public park on the top. Sada had brought his son, Jo, who had insisted to be taken along on a trip to collect bugs. We parked the car along the road and began walking down one of the trails together, Sada and his son behind me. As soon as we started walking, I saw what appeared to be a yellow object fluttering to the ground. Instinctively, I shouted 'There!' and pointed. Before I could begin chasing, Sada had already run ahead of me to attempt to catch it. He approached the butterfly quickly and the butterfly began to fly. He swung the net haphazardly, and the butterfly flew up into the canopy. 'Kuso!' he yelled, 'Mochotto datta no ni!' (meaning 'Darn, I almost had it!'). When the next one appeared, he swung his net and caught it in mid-flight. He shouted with joy, 'Yatta!'

Because the butterfly is quite rare, we released all but a couple. Sada still speaks of how he felt when he caught that insect.

At one point during our walk, Jo pointed to the ground and said, in Japanese, 'there is one here that is bending its body.' We moved slowly to the butterfly and saw that it was a female laying an egg on wild ginger, *Asarum* sp., its host plant. I explained the natural history of the butterfly and we watched for a few minutes before it few away. Jo carefully collected the leaves on which the eggs were laid and put them in a Tupperware container so that he could observe them. The eggs turned into caterpillars and were kept in his home and reared until they turned into butterflies. Jo is now 13, and that experience, among others, triggered an interest in the natural world, and has led him to consider a career in entomology.

CHILDREN AND NATURE

Educating children about the natural sciences is critically important at a time when global diversity is declining at an alarming rate and humans are becoming increasingly distanced from nature (Louv 2005, 2011). Regardless of ethnicity or background, children are inherently curious about the natural world (Bjerke *et al.* 1998a; Kellert 2002). Entomologists, professional amateurs and insect enthusiasts reading this book may recall how playing with living things in the outdoors during their formative years led to a deep interest and respect for natural history. But does this interest peak at a particular time during their development?

While children are often perceived as being interested in animals at all ages, there is a time when their interest will heighten. From an entomological perspective, we could almost conclude that all kids are born entomologists until they learn not to be. Indeed, studies have shown that effective and emotional relationships with animals are greatest between the ages of 6 to 12 years, and gradually decline thereafter (Kellert 2002). This general trend has been described in several other independent studies (e.g., Bjerke *et al.* 1998b; Bunting and Cousins 1985). These findings imply a narrow window for reaching kids to instil a deep concern for nature, and thus an optimal period for getting nets and other tools to promote natural history education into their hands.

Kellert and Westervelt (1983) classified children's appreciation of animals into nine groups, and discovered that the most common responses can be categorized into *humanistic* (strong affection towards

animals, such as pets), *naturalistic* (appreciation for wildlife and the outdoors) and *negativistic* (avoidance, dislike and fear) attitudes. The humanistic and naturalistic attitudes were highest among children who owned pets or frequently interacted with farm animals, regardless of gender or race. Children who took part in activities such as hunting and birdwatching also showed higher appreciation for natural history and lower negativistic scores than those who did not. Numerous other studies confirm this trend (Bjerke *et al*. 1998a; Kellert 1985; Paul and Serpell 1993). Unfortunately, among mammals, birds, amphibians, fish and arthropods, the latter receive the lowest humanistic and naturalistic scores and the highest negativistic score (Kellert 1993). Why do insects and other arthropods score lowest?

Numerous reasons may account for why the public perceives insects in this way. Kellert (1993) summarized some of these: it may be difficult for humans to relate to insects because they differ in morphology, behaviour and abundance from our own species, and because they often respond unpredictably in our home. Popular culture can also create inaccurate myths, which include the presumed connection between arthropods and human disease (e.g. McNeill 1976). Moreover, the English language contains terms such as 'bug-eyed', 'spidery' and 'worm', which indicate human traits that lack warmth (Hillman 1991). Parents, who are largely influenced by the media, may be at fault because they can have the greatest influence on a child's thoughts.

Surprisingly, most children know far more about insects than do their parents. Comments from a parent to a child should not be, 'don't touch that spider, it is disgusting', but might be replaced with 'spiders are very interesting animals, they produce silk, one of the strongest materials on the planet'. Kellert (1985) demonstrated that eleventh graders were significantly more knowledgeable than adults on questions concerning invertebrates. For example, 78% of all children (86% of all eleventh graders) knew that spiders do not have ten legs, while only 50% of adults knew this. Only 23%of adults, compared to 48%of 16-year-olds knew that inchworms and earthworms were not in the same phylum. Children living in rural areas scored much higher than kids in urban areas (Kellert 1985). While the outlook does not appear very positive, negativistic views can be changed by proper education and exposure to natural history at the right time during childhood. Children who form the habitat of outdoor exploration may, in time, overcome their negative feelings toward certain aspects of nature. In his book *Wintergreen*, the second author describes his long conflict between a passion for butterflies and deep, crippling arachnophobia,

and how he eventually bested it through intentional practice: getting to know spiders first hand, beginning with small, unthreatening species and building up to large, bulbous orb-weavers and tarantulas (Pyle 2006). A cultural change will need to take place to promote a greater appreciation of insects, much like what we find in Japan.

FOSTERING A WORLD THAT CHERISHES INSECTS: ENTOMOLOGY IN JAPAN

Insects have a central role in many Asian countries, and their presence is especially pronounced in modern Japan. Children are frequently seen carrying nets and cages in city parks (Figure 9.1). Japanese boys and their fathers frequently keep horned rhinoceros and stag beetles in their homes as pets. Beetles are sold in vending machines and department stores, and are accessible via petting zoos. Part of the pet section in a Japanese department store is converted during the summer into an 'insect corner' where different species of beetles are sold in cages, along with basic insect collecting and rearing equipment, general entomology books and plastic cages. Beetle pets are displayed alongside cat toys, dog food and goldfish. When people visit an established collecting locality for insects, they will frequently encounter other amateur collectors frantically seeking their prized insects (Kawahara 2007).

Insects are also found elsewhere in modern Japanese culture, including firefly festivals, documentaries, popular television shows, candies, toys and videogames. Children's books are also translated into Japanese directly from old Victorian entomological literature. The most popular of such books is the ten-volume series written by Jean-Henri Fabre (1823–1915), the famous French entomologist who wrote *Souvenirs Entomologiques* (Fabre 1879–1907) a monumental work that included detailed observations on insect behaviour. Fabre's books have become so popular that in the summer of 2005, the 7-Eleven convenience store chain gave away eight plastic renditions of various insects that Fabre studied as a promotion to help boost sales (Kawahara 2007). One of the most notable was *Scarabaeus typhoon* (Fischer-Waldheim) rolling a large ball of dung. Can you image the reaction of a 7-Eleven customer in the United States if given a ball of plastic dung with a beetle figurine as a gift for purchasing a soda?

The insect theme also appears frequently in Japanese videogames. Satoshi Tajiri, the creator of the successful animation 'Pokémon,'

Figure 9.1 Japanese children collecting insects in a city park. Photo by Kenji Nishida.

enjoyed collecting insects as a child and his experiences inspired him to develop the animation that would 'capture the excitement and fun of bug hunting' (IGN 2011). In a recent count, there were up to 15 different insect collecting games and insect battle games in Japan, available for multiple gaming platforms. Some of these were explained in Kawahara (2007) and appear in the documentary film 'Beetle Queen Conquers Tokyo' (Oreck 2010).

According to the developers of the very successful children's videogame 'Mushi-King', the game was developed not only to target kids, but also their parents. 'The parents … can relate to [beetles] as well. Fathers remember catching and keeping beetles when *they* were kids' (Wallace 2005: A9). The first author doubts that he would be writing this article today if it were not for his father's childhood experiences collecting butterflies and the widespread availability of Japanese entomological supplies. The day that helped direct his career path as an entomologist came when his father walked into a Japanese department store and accidentally came upon insect collecting equipment. He bought a net for him, as the equipment in the store brought back memories of his childhood experience rearing insects. His father's gift

led him to be immediately captivated by the net, and become fascinated with collecting, collecting anything that moved.

Thus, the combination of parents' entomological experiences during childhood and availability of entomological resources fosters proper education about insects. When these children become parents themselves, they too are likely to provide positive feedback about insects. This education process can continue over generations, and helps strengthen the society's overall appreciation for entomology and natural history. The memory of collecting a rare insect and learning about it seems never to leave one's mind. In his autobiography, Charles Darwin wrote, 'I am surprised what an indelible impression many of the beetles which I caught at Cambridge have left on my mind. I can remember the exact appearance of certain posts, old trees and banks where I made a good capture. …I had never seen in those old days *Licinus* alive, which to an uneducated eye hardly differs from many of the black Carabidous beetles; but my sons found here a specimen, and I instantly recognised that it was new to me; yet I had not looked at a British beetle for the last twenty years' (Barlow 1958: 61).

WHERE DO WE STAND, AND WHAT CAN WE DO?

The current state of natural history education in the United States is of great concern. A study showed that American children between second and eleventh grade, only 52% knew that penguins are birds, and only 29% knew that Koala bears are not really bears (Kellert 1985). Orr (1994: 126) stated, 'Even in this time of ecological concern, high schools, colleges, and universities continue to turn out a large percentage of graduates who have no clue how their personal prospects are intertwined with the vital signs of the earth.' The second author attributed this problem largely to the lack of accessible habitat near the child's home. He wrote,

> Most kids used to wander freely and catch fireflies in a jar – or crawdads, or polliwogs – and, through those encounters, learned to connect with the land on which we all depend. These days, their attachment to electronica almost from birth, combined with parents' fears for their child's safety and the loss of accessible habitats close to home, means that this fundamental experience of roaming freely is increasingly rare. Where will our future conservationists and biologists come from, when kids no longer chase grasshoppers in real life? Well, there is no more effective defense against nature deficit disorder than the butterfly net!' (Pyle 2009: 57–58).

Thus it is of primary importance to engender greater appreciation among the general public toward insects and other arthropods. Ambitious education programmes that touch on the positive values of insects are increasingly necessary.

In order to counter the general trend in the United States, several organizations have pushed forward to change this perception. For example, the Lepidopterists' Society has developed the Outernet Project (http://www.lepsoc.org/education.php), which helps place butterfly nets into the hands of children so that they can explore, sample and learn about entomology. The society is teaming with the entomological supply company BioQuip Products to provide youngsters with a free insect net, spreading board, insect box, insect pins and insect collection booklet, when kids join The Lepidopterists' Society; or at a small expense if they choose not to join. The Outernet Project started a partnership with many local insect clubs in the United States, and some, such as the Utah Bug Club, teach children how to collect, mount, and curate butterflies (http://www.utahbugclub.org). There is also 'Firefly Watch', a project that tracks the distribution of fireflies in the Eastern United States during the summer. Participants can log onto a website and input firefly data that they observed in their backyard. The organization then utilizes these data to construct real-time distribution maps for many species and determine their population fluctuations. These data become available to the participants and educates them about fireflies.

Another method to enhance natural history education is to bring often negatively perceived 'creepy-crawly' arthropods, directly to students in the classroom (See Ernst *et al.* and Rykken and Farrell, this volume). The 'Insect Zoo' on Maryland Day, held at the University of Maryland College Park campus annually, introduces a diversity of arthropods, both live and pinned, to the public. A long line often forms outside the event room each year, and participants are encouraged not just to look, but to touch the tarantulas, stick insects and hissing cockroaches. Terrified parents watch their children hold the insects, and then later decide they should try holding them too. Instructors educate students about the natural history of each arthropod (Figure 9.2).

One of the most notable examples of bringing arthropods to students is Dr Linda Rayor's 'Spider Biology' course at Cornell University, which she has taught for 17 years. This very popular course teaches students about every aspect of the biology of spiders, and includes a take-home extra credit assignment that allows students to learn about the natural history of their pet spiders. We followed the example set

Figure 9.2 Children learn from an instructor about arthropods at University of Maryland's 'Insect Zoo', part of annual the 'Maryland Day' event. Photo by Paula Shrewsbury.

forth by Dr Rayor and proposed a similar project at the University of Maryland in David Hawthorne's BSCI 120 Insect Biology course in 2006, which had an enrolment of 100 undergraduate students, most of whom were taking the course simply to fulfil their science requirement. Like Dr Rayor's course, we offered the students the option of extra credit – 15% of their total grade – for caretaking pet tarantulas. At first the students were very hesitant. But 92 of 100 decided they needed the extra points enough to push their fears aside and participate in tarantula care and observation. During the course of the semester, some became so attached to their baby tarantulas that they named them, and some even went to the extent of carrying them to every class they attended. Approximately a third of the students kept their spiders after the course ended, saying that they could not part with their pet.

In the BSCI 120 course, we also took students to a small field near the football stadium on campus. We handed each student a net and said, 'Go catch whatever you can!' Students at first were reluctant to venture into the field, but once they started searching, they couldn't stop. After the 30-minute outing was over, only 2 students out of 15 had returned. One of the most memorable participants was a 300-pound linebacker on the college football team. After running around the field with the net that looked like a plastic spoon next to

his huge body, he returned and said, 'This was the best experience I ever had in a class, I want to do it again'. The same student wrote to me several years later and told me that he hadn't forgotten that experience and had bought his son a bug collecting kit.

Some people and organizations view insect collecting as an activity best avoided, since it involves the killing of its subjects. However, the great preponderance of informed fact and opinion favours the conclusion that collecting very rarely offers a threat to the conservation of insect populations (Pyle *et al.* 1981). As fecund invertebrates, most insects replace their numbers rapidly; and people with butterfly nets are not, for the most part, very effective predators. Also, collectors commonly target the more colourful and dramatic males, which further buffers potential losses, since females are more expensive to the population. Almost all serious danger to rare insects comes from habitat (and now climate) alteration. And it can certainly be said with confidence that most insect conservationists were originally beguiled and inspired by collecting.

Furthermore, one must take into account what a child can gain from placing an insect in his or her hand. Direct contact, through making an insect collection, teaches the child about the characters that are used to distinguish taxa in ways that a photograph or illustration in a book cannot accomplish. Such close observation frequently leads to curiosity about the animals' lifeways and environmental adaptations; young entomologists become young botanists, geologists and climatologists; and all of the life sciences benefit, along with the environment.

Some prominent butterfly clubs promote optical encounters with insects to the exclusion of nets. This has led to a divisive 'watching versus catching' debate (Pyle 1992). However, such a schism in the entomological world is unnecessary and diverting from the very real need for all bug-lovers to cooperate on behalf of habitat conservation. For one thing, optics simply do not replace nets in a child's experience. Give a boy a pair of binoculars or a camera, and he will be engaged momentarily; but give a girl a net, and watch her go! Besides, if the captor is concerned about killing the insect, it can be let go after being placed in one's hand, or on a plant. The second author frequently teaches through catch-and-release. And while conservation should certainly be kept in mind when collecting insects, it is generally easy to avoid species with conservation concerns mainly because they tend to be rare, and thus, coming in contact with them is not very common. If one does encounter a species of concern, it may be

released without harm, or merely observed. Children taking part in the Outernet Project are provided with a copy of the Lepidopterists' Society's conservative Collecting Guidelines, to encourage good, careful practice. We believe on the whole that the social value of nets vastly outweighs their liability.

CONCLUSION

Collecting, rearing and observation can be readily done with appropriate, simple equipment. It can be conducted practically anywhere, such as in one's backyard or nearby park. Easy yet challenging, one of most enjoyable and least expensive of outdoor activities, insect collecting can greatly improve one's appreciation for the natural world. In Japan, the availability of insect collecting equipment and supplies allows many Japanese insect hobbyists to make personal collections and further the science of entomology. These Japanese collections are the result of an appreciation for natural history in Japanese culture, which begins at childhood.

Japanese children are educated about insects mainly through collecting, but their interest in learning about insects is supported by the culture, which produces an outstanding number of children's books, television programmes, and insect-related toys and videogames. When these children become adults, they help teach their children about entomology, and an interest in entomology continues for generations. This transfers into a concern for habitat to support the treasured insect resource. The portrayal of insects as being scary, gross and creepy is often misleading, scientifically inaccurate and does not help teach the general public about natural history. We must not harm the children's innate interest to learn about natural history by brainwashing them with incorrect facts. We should let them decide for themselves, by providing them with nets and jars, and then letting them explore the fascinating outdoor world on their own.

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