

**THE SIGEO-CTFS ARTHROPOD INITIATIVE
ANNUAL REPORT 2013 – EXECUTIVE SUMMARY**

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Background. The ‘Arthropod Initiative’ of the Center for Tropical Forest Science (CTFS) aims at monitoring key arthropod assemblages over long-term and studying insect-plant interactions over the network of the Smithsonian Institution Global Earth Observatories (SIGEO, <http://www.ctfs.si.edu/group/arthropod%20monitoring/>). The Initiative integrates with ongoing monitoring of plant dynamics within the SIGEO network, causes minimum possible impact to the plots and focus on a priority set of assemblages chosen for their ecological relevance, taxonomic tractability and ease of sampling. At each participating SIGEO site, the first year of the program is devoted to a ‘baseline’ survey to serve several purposes, notably to refine the methodology and the definitive choice of assemblages. The baseline survey is followed by longer-term programs of field work and analysis, organized into two main sub-programs: monitoring, and key interaction studies. The monitoring sub-program is directed to detecting long-term changes, as reflected in priority assemblages, driven by climatic cycles, climatic change and landscape scale habitat alteration. Monitoring protocols are derived from those used during the baseline survey. The food web approach of interaction studies targets interactions between plants and specific insect assemblages, with different protocols than those used for monitoring. So far, the Arthropod Initiative involves five SIGEO sites: Barro Colorado Island (BCI) in Panama, Khao Chong (KHC) in Thailand, Wanang (WAN) in Papua New Guinea, Yasuni in Ecuador and Hong Kong in China. All insect protocols are performed in BCI and KHC, whereas so far only butterfly transects are performed at WAN and Hong Kong, and the Winkler protocol for litter ants at Yasuni.

Taxonomy. In collaboration with Paul Hebert (University of Guelph), insect legs are harvested to provide DNA barcodes for each of our focal species. This greatly helps refining insect taxonomy and the project is now well underway at BCI and KHC. All information, including insect pictures, is stored on the web site of the International Barcode of Life Project (BOLD, <http://www.barcodinglife.org/>) and are gradually becoming public as soon as data are deemed to be reasonably clean. The taxonomic study of our material at BCI has significantly improved over 2012, notably for moths, ants and flatids. A Smithsonian grant facilitated the addition of 3,124 DNA sequences, and several experts revised our collections. Our aims remain to (a) prepare reference collections supported by pictures and DNA barcodes, and (b) invite interested taxonomists to study our material when (a) is reasonably accurate. We received a \$19,556 grant from the Smithsonian Institution Barcoding Opportunity FY013 to defray costs of insect DNA barcoding at KHC next year.

Monitoring – BCI. The BCI database now displays internet links to the Barcodes Index Numbers (BINs) hosted by BOLD, which allows checking conveniently the occurrence of cryptic species. Year 2013 represented the fifth year of insect monitoring at BCI. So far, the BCI database contains data on 309,292 arthropods, including 1,643 species (78% of which with pictures) and 31,313 pinned specimens in our collections. With the improvement of our collections, our routine has likely greatly improved. Many insect specimens that belong to common species well recognized morphologically and described by DNA barcodes are not pinned anymore, unless they are in a pristine state. We estimated annual indices of population in 2013 for all focal taxa, and for the most common species within these groups. These estimates were calculated separately for non-social and social insects. All together our five protocols provided annual indices for 54 species from our focal groups (8% of the total 704 focal species collected in 2013). These 54 species represented 45% of the total abundance of focal taxa (22,975 individuals collected in 2013), indicating that our protocols characterize well our focal taxa. We assessed temporal changes in several assemblages during 2009-2013. Directional changes appear to be few, with the exception of perhaps litter ants. Temporal patterns also appear to be unrelated between taxa. This simple analysis emphasized the need to monitor different arthropod taxa, as their responses to environmental stress may be rather different.

Monitoring – KHC and WAN. Year 2013 represented the third and first years of insect monitoring at KHC and WAN, respectively. At KHC most of the material collected in 2013 has been processed (the remaining backlog will be absorbed next year), and our database includes 114,260 specimens (22,586 pinned specimens in collections) and 1,996 focal species. One volunteer student from Oxford University helped the project during two months. At WAN, butterfly transects are now in routine mode. A motorized balloon flew over the WAN plot to collect insects from the forest canopy in April 2013. This represented the first flight of an air balloon in Papua New Guinea.

Interaction studies. A three-year grant from the Grant Agency of the Czech Republic (\$323,121) allowed to replicate the seed predation protocol established at BCI in the plots of KHC and WAN. The project aims at comparing quantitative food webs based on seeds and their insect predators and parasitoids at BCI, KHC and WAN.

Scientific output. The BCI and KHC teams continue to prove that our model is viable and that with a minimum of organization and personnel, insect population can be monitored with high accuracy that will allow statistical analysis of annual data and, therefore, of long-term changes in insect populations. In 2013, the CTFS Arthropod Initiative trained 14 assistants and interns at BCI, KHC and WAN. The value of our now considerable insect collections at BCI and KHC is augmented by collateral information such as sampling data, pictures and, for many specimens, genetic sequences (DNA barcodes). We hope that our mini-network consisting of 5 sites may further expand in 2014 (Gabon, China), and that some of the participating sites, such as WAN, Yasuni or Hong Kong, may also initiate additional protocols than the one currently in use. Our aims remain consolidating our arthropod protocols and activities at the three current main participating SIGEO sites of BCI, KHC and WAN.

Plate I. Representative activities/items for the CTFS Arthropod Initiative in 2013: (1) Thumbnail pictures of fruits/seeds collected at KHC; (2) one of the *Phostria* species determined by A. Solis; (3) the air balloon inflated near the Wanang plot; (4) screenshot of the BCI database displaying a list of clickable Barcode Index Numbers for each morphospecies; (5) the corresponding BIN window from the BOLD database; (6) a brief story about butterfly transects in the STRI News of July 2013; (7) S. Gripenberg and C. Dahl trekking to the Wanang plot; (8) Details of the molecular tree for the 805 sequences of Arctiinae for BCI; (9) C. Dahl inspecting seed rearing containers at Wanang; (10) draft guide of Wanang butterflies; (11) C. Chung performing butterfly transects at Hong Kong; (12) illustrated guide for BCI Flatidae with genitalia sketches.

