# CEPF SMALL GRANT FINAL PROJECT COMPLETION REPORT

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| **Organization Legal Name:** | Humboldt State University, Sponsored Programs Foundation |
| **Project Title:** | Mainstreaming Ecosystem Service Values into Agricultural Practices: The Value of Native Shade Trees and Forest to Coffee Farms in Central and Western Jamaica |
| **Date of Report:** | 27 February 2014 |
| **Report Author and Contact Information** | Dr. Matt Johnson, Dept Wildlife, Humboldt State University, Arcata CA 95521<br>matt.johnson@humboldt.edu |

**CEPF Region:** Caribbean Islands

**Strategic Direction:** (1) Improve protection and management of 45 priority key biodiversity areas. (2) Integrate biodiversity conservation into landscape and development planning and implementation in six conservation corridors. (3) Support Caribbean civil society to achieve biodiversity conservation by building local and regional institutional capacity and by fostering stakeholder collaboration.

**Grant Amount:** $19,645

**Project Dates:** 30 April 2013 to 31 Dec 2013

**Implementation Partners for this Project (please explain the level of involvement for each partner):**

The project has partnered with the Coffee Industry Board, with Mr. Gusland McCook as the lead partner. CIB assisted with the identification of focal farms in the Catadupa and western/northern edge of the Cockpit Country for the field research phase. In addition, CIB was instrumental in coordinating the workshop described in the dissemination phase.

## Conservation Impacts

***Please explain/describe how your project has contributed to the implementation of the CEPF ecosystem profile.***

This project had three phases: (1) field research, (2) analyses, and (3) dissemination. Field research occurred in summer (2013), when coffee fruits were ripening and vulnerable to the coffee berry borer, *Hypothenemus hampei*, the world's most economically damaging pest in coffee. Using the Jamaican Coffee Industry Board's database of coffee farms, we identified farms near Catadupa and the western or northern edge of the Cockpit Country. We visited each farm to document the diversity of shade trees growing over coffee. In the morning hours (sunrise to 10:00) we performed 20-min 'focal observations' on individual shade trees, at least 5 per common tree species on each farm. During the observations, we recorded foraging birds following established protocols. Field work was conducted by M. Johnson and his students.

Analyses occurred in fall and winter 2013. Statistical analyses of bird use of shade tree species revealed which trees are most effective at harboring insect-eating birds

likely to provision pest control services. We found that *Inga vera* and *Gliricidia sp.* were especially good and hosting insectivorous birds. Using existing mathematical models (Railsback and Johnson 2011), we converted bird foraging activity into potential economic gain using typical crop yields and the most current crop prices available from the Coffee Industry Board. In addition, we used established relationships between proximity to forest habitats and the provisioning of pest control services (Jirinec et al. 2011) to reveal how the surrounding landscape (forest and patches of trees) contributes to the delivery pest control. This work was recently published in the Proceedings of the National Academy of Sciences (Railsback and Johnson 2014).

Dissemination of this work was accomplished in collaboration with the Coffee Industry Board (CIB) with a workshop (November) held in Cambridge Jamaica. The workshop was advertised and promoted by CIB and was well attended, with over 30 persons in attendance. There were multiple presentations (from CIB and Johnson) on the value of shade trees, followed by a round table discussion of the issues farmers face in choosing, maintaining, and managing coffee with shade in the Cockpit Country. A full-color informational brochure (trifold) was made available free to all attendees (Appendix B). A short report for RADA and CIB was also prepared and disseminated to these groups (Appendix C).

***Please summarize the overall results/impact of your project against the expected results detailed in the approved proposal.***

The project yielded several important results/impacts. First, we quantified the value of existing forests and trees in delivering ecosystem services. More specifically, we learned that shade trees attract insect-eating birds that consume coffee berry borer to an extent that offset the loss of raw yields from enhanced shade. In the absence of the shade coffee, small patches of trees on the landscape (5%) maximize profits and, again, offset any loss in revenue from less area under cultivation. These findings are detailed in Railsback and Johnson (2014), a recent paper was has been picked up by the press (http://news.sciencemag.org/environment/2014/04/scienceshot-more-trees-more-coffee#disqus_thread; and http://www.abc.net.au/science/articles/2014/04/08/3977714.htm). Second, our bird foraging observations revealed that leguminous trees, especially *Inga vera* and *Glicirida sp.*, are among the most effective at attracting insect-eating birds to coffee farms. Third, we offered a workshop in November to disseminate this information specifically to farmers in the project area, and we learned from them about some of the constraints for growing shade trees. Fourth, we produced a full-color flyer that was disseminated to all participants of the workshop (Appendix B), as well as other farmers. And fifth, we drafted summarizing reports disseminated to CIB and RADA (Appendix C).

***Please provide the following information where relevant:***

**Hectares Protected:** This project was not designed to protect hectares directly. However, through our “shade coffee workshop”, we communicated effectively the value of forest patches to coffee farmers near the Cockpit Country in Jamaica.
**Species Conserved:** The recognition of the importance of maintaining shade trees and forest patches for the delivery of pest control services on coffee farms in Jamaica will help conserve forest associated birds, including those in Appendix A.
**Corridors Created:** NA
**Other information:** The farmers in our workshop learned the value of pest control services provided by birds, and they learned of the links between shade trees, forest

patches, birds, and the delivery of those services. In turn, I and collaborators learned of some of the motivations and constraints for shade experiences by coffee farmers in the region, and we learned more about preferred shade tree species.

***Describe the success or challenges of the project toward achieving its short-term and long-term impact objectives.***

The project achieved its short-term objectives: all data were collected, analyzed, and disseminated via a full-color brochure delivered to farmers and the CIB (see Appendix B). We were unable to collaborate with RADA due to limited time and communication challenges. Long-term impacts of this project, and others like it at aimed at reconciling conservation and agriculture, will be measured by the degree to which coffee growing in Jamaica ceases to expand at the expense of forested habitats, and instead expands by making marginal land more profitable for an exported agricultural product while protecting native biodiversity.

***Were there any unexpected impacts (positive or negative)?***

None.

## Lessons Learned

***Describe any lessons learned during the design and implementation of the project, as well as any related to organizational development and capacity building. Consider lessons that would inform projects designed or implemented by your organization or others, as well as lessons that might be considered by the global conservation community.***

***Project Design Process: (aspects of the project design that contributed to its success/shortcomings)***

None.

***Project Implementation: (aspects of the project execution that contributed to its success/shortcomings)***

One lesson I have learned is the value of collaborating with local agencies. I ran a workshop to disseminate information to farmers in the Blue Mts of Jamaica a number of years ago. In that case, I organized the workshop and its promotion and advertisement myself, with some collaboration from NEPA. This time (with this CEPF grant), I included funds in the grant to pay staff from the Coffee Industry Board to help coordinate the workshop. It was very successful; they did a great job. I also learned that is was more difficult to coordinate with RADA that initially anticipated. Despite numerous emails and a couple of phone calls, we were unable to contact RADA prior to the workshop with the limited time and funds available for this project. Nonetheless, the workshop organized with CIB was extremely successful and was effective for disseminating information directly to farmers.

***Other lessons learned relevant to conservation community:***

In addition, we learned that *Inga vera*¸ which has been a popular shade tree for farmers, is no longer preferred because of nuisance black ants. Although *Inga vera* is valuable from a bird and conservation perspective (it harbors high insect abundance, fixes

nitrogen, etc.), it is important to work within realistic parameters faced by farmers. *Cedrela odorata* is a more preferred shade tree by farmers, and it shares some of the same ecological qualities as *Inga vera.* *Cedrela* is preferred because its timber can be easily marketed locally. However, we also learned farmers in the region currently do not have adequate access to saplings of *Cedrela* or *Coffea*. This is something the CIB now recognizes. Hopefully, this information may lead to changes in policy or practice to make the trees more available.

## ADDITIONAL FUNDING

***Provide details of any additional donors who supported this project and any funding secured for the project as a result of the CEPF grant or success of the project.***

| Donor | Type of Funding* | Amount | Notes |
|---|---|---|---|
| None. | | | |
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***Additional funding should be reported using the following categories:**

***A*** *Project co-financing (Other donors contribute to the direct costs of this CEPF project)*

***B*** *Grantee and Partner leveraging (Other donors contribute to your organization or a partner organization as a direct result of successes with this CEPF project.)*

***C*** *Regional/Portfolio leveraging (Other donors make large investments in a region because of CEPF investment or successes related to this project.)*

## Sustainability/Replicability

***Summarize the success or challenge in achieving planned sustainability or replicability of project components or results.***

The long term success of this project, and others like it aimed at reconciling conservation and agriculture, will be measured by the degree to which coffee growing in Jamaica ceases to expand at the expense of forested habitats, and instead expands by making marginal land more profitable for an exported agricultural product while protecting native biodiversity. That, of course, is a lofty goal beyond the reach of any single project. Nonetheless, previous work has resulted in substantial improvements in coffee cultivation practices in Jamaica, and there is growing recognition that forest and trees are helpful for agriculture, especially coffee. This project has helped realize lasting change by advancing that recognition, working to disseminate the message of the value of forest and trees, and by offering practical advice to farmers and policy makers about specific native tree species to maintain shade for coffee that will also attract native birds that provision economically important pest control. More specifically, this project supported farmer support organizations (e.g., CIB) by identifying appropriate conservation practices to recommend to farmers that will yield economic benefits to farmers. These identifications are tangibly reported in a full-color brochure disseminated to farmers and the CIB.

The pamphlet we designed and disseminated to farmers was effective, and more can be easily printed and distributed (See Appendix B). Reports to CIB and RADA that detailed the methodology, data, and analysis were also provided (see Appendix C).

***Summarize any unplanned sustainability or replicability achieved.***

I had a student travel to the Blue Mts to conduct some interviews with coffee farmers (a project unrelated to this current CEPF project), and she disseminated the pamphlet to over 100 farmers in that region. This occurred outside the project area.

## Safeguard Policy Assessment

***Provide a summary of the implementation of any required action toward the environmental and social safeguard policies within the project.***

None.

## Additional Comments/Recommendations

None.

## Information Sharing and CEPF Policy

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned, and results. Final project completion reports are made available on our Web site, www.cepf.net, and publicized in our newsletter and other communications.

**Please include your full contact details below:**

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Literature Cited

Jirinec. V. B.R. Campos, M.D. Johnson. 2011. Roosting behavior of a migratory songbird on Jamaican coffee farms: Implications for ecosystem services. *Bird Conservation International* 21: 353-361.

Johnson, M.D., J.L. Kellermann, and A.M. Stercho. 2010. Pest control services by birds in shade and sun coffee in Jamaica. *Animal Conservation* 13: 140-147.

Kellermann, J.L., M.D. Johnson, A.M. Stercho, and S. Hackett. 2008. Ecological and economic services provided by birds on Jamaican Blue Mountain coffee farms. *Conservation Biology* 22:1177-1185.

Railsback, S.F., M.D. Johnson 2014. Effects of land use on bird populations and pest control services on coffee farms. *Proceedings of the National Academy of Sciences* doi: 10.1073/pnas.1320957111

Railsback, S.F., and M.D. Johnson. 2011. Pattern-oriented modeling of bird foraging and pest control in coffee farms. *Ecological Modelling* 222: 3305-3319.

*****If your grant has an end date other than JUNE 30, please complete the tables on the following pages*****

## Performance Tracking Report Addendum

### CEPF Global Targets

# (Enter Grant Term)

**Provide a numerical amount and brief description of the results achieved by your grant.**
**Please respond to only those questions that are relevant to your project.**

| Project Results | Is this question relevant? | If yes, provide your numerical response for results achieved during the annual period. | Provide your numerical response for project from inception of CEPF support to date. | Describe the principal results achieved from July 1, 2007 to June 30, 2008. (Attach annexes if necessary) |
|---|---|---|---|---|
| 1. Did your project strengthen management of a protected area guided by a sustainable management plan? Please indicate number of hectares improved. | NA | | | Please also include name of the protected area(s). If more than one, please include the number of hectares strengthened for each one. |
| 2. How many hectares of new and/or expanded protected areas did your project help establish through a legal declaration or community agreement? | NA | | | Please also include name of the protected area. If more than one, please include the number of hectares strengthened for each one. |
| 3. Did your project strengthen biodiversity conservation and/or natural resources management inside a key biodiversity area identified in the CEPF ecosystem profile? If so, please indicate how many hectares. | | | | |
| 4. Did your project effectively introduce or strengthen biodiversity conservation in management practices outside protected areas? If so, please indicate how many hectares. | Yes, we communicated with farmers that collectively managing over 500 ha | 500 ha | 500 ha | |
| 5. If your project promotes the sustainable use of natural resources, how many local communities accrued tangible socioeconomic benefits? Please complete Table 1below. | 1 | 1 | 1 | |

**If you answered yes to question 5, please complete the following table.**

## Table 1. Socioeconomic Benefits to Target Communities

**Please complete this table if your project provided concrete socioeconomic benefits to local communities. List the name of each community in column one. In the subsequent columns under Community Characteristics and Nature of Socioeconomic Benefit, place an X in all relevant boxes. In the bottom row, provide the totals of the Xs for each column.**

| Name of Community | Community Characteristics | | | | | | | | Nature of Socioeconomic Benefit | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Increased Income due to: | | | | | | | | | | | | |
| | Small landowners | Subsistence economy | Indigenous/ ethnic peoples | Pastoralists/nomadic peoples | Recent migrants | Urban communities | Communities falling below the poverty rate | Other | Adoption of sustainable natural resources management practices | Ecotourism revenues | Park management activities | Payment for environmental services | Increased food security due to the adoption of sustainable fishing, hunting, or agricultural practices | More secure access to water resources | Improved tenure in land or other natural resource due to titling, reduction of colonization, etc. | Reduced risk of natural disasters (fires, landslides, flooding, etc) | More secure sources of energy | Increased access to public services, such as education, health, or credit | Improved use of traditional knowledge for environmental management | More participatory decision-making due to strengthened civil society and governance. | Other |
| Cambridge/Catadupa coffee farming community | X | X | X | | | | X | | X | | | | X | | | X | | | X | | |
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| **Total** | **1** | **1** | **1** | | | | **1** | | **1** | | | | **1** | | | **1** | | | **1** | | |

**If you marked "Other", please provide detail on the nature of the Community Characteristic and Socioeconomic Benefit:**

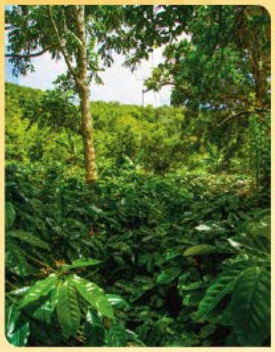
Appendix A. List of forest-associated bird species that benefit from shade trees grown on coffee farms near the Cockpit Country of Jamaica.

| Common Name | Scientific Name |
|---|---|
| American Redstart | *Setophaga ruticilla* |
| Arrow-headed Warbler | *Setophaga pharetra* |
| Black-and-white Warbler | *Mniotilta varia* |
| Black-billed Parrot | *Amazona agilis* |
| Black-throated Blue Warbler | *Setophaga caerulescens* |
| Black-throated Green Warbler | *Setophaga virens* |
| Chestnut-bellied Cuckoo | *Hyetornis pluvialis* |
| Greater-Antillean Bullfinch | *Loxigilla violacea* |
| Jamaican Becard | *Pachyramphus niger* |
| Jamaican Blackbird | *Nesopsar nigerrimus* |
| Jamaican Crow | *Corvus jamaicensis* |
| Jamaican Elaenia | *Myiopagis cotta* |
| Jamaican Euphonia | *Euphonia jamaica* |
| Jamaican Lizard Cuckoo | *Saurothera vetula* |
| Jamaican Mango | *Anthracothorax mango* |
| Jamaican Oriole | *Icterus leucopteryx* |
| Jamaican Owl | *Pseudoscops* grammicus |
| Jamaican Pewee | *Contopus pallidus* |
| Jamaican Spindalis | *Spindalis nigricephala* |
| Jamaican Tody | *Todus todus* |
| Jamaican Woodpecker | *Melanerpes radiolatus* |
| Northern Parula | *Parula americana* |
| Northern Waterthrush | *Parkesia noveboracensis* |
| Olive-throated Parakeet | *Eupsittula nana* |
| Ovenbird | *Seiurus* aurocapilla |
| Prairie Warbler | *Setophaga discolor* |
| Red-billed Streamertail | *Trochilus polytmus* |
| Rufous-tailed Flycatcher | *Myiarchus validus* |
| Rufous-throated Solitaire | *Myadestes genibarbis* |
| Sad Flycatcher | *Myiarchus barbirostris* |
| Swainson's Warbler | *Limnothlypis swainsonii* |
| White-chinned Thrush | *Turdus aurantius* |
| White-eyed Thrush | *Turdus jamaicensis* |
| Yellow-billed Parrot | *Amazona collaria* |
| Yellow-shouldered Grassquit | *Loxipasser anoxanthus* |
| Yellow-throated Warbler | *Setophaga dominica* |

Appendix B. Image of front and back of tri-fold brochure.

## WHAT ARE THE BENEFITS OF SHADE TREES?

- Produce fruit & timber
- Attract pest-eating birds
- Reduce soil erosion
- Improve soil fertility
- Lower air & soil temperatures
- Reduce wind damage
- Improve soil moisture & availability
- Reduce overbearing stress
- Reduce weed growth
- Possible "certification" that can bring higher prices



## FOR MORE INFORMATION, SEE:

http://nationalzoo.si.edu/scbi/migratorybirds/coffee/bird_friendly/ecological-benefits-of-shade-grown-coffee.cfm

http://www.humboldt.edu/wildlife/faculty/johnson/pdf/Johnson_etal_2010.pdf

http://news.nationalgeographic.com/news/2008/08/080826-jamaica-coffee-birds-missions.html

http://www.rainforest-alliance.org/work/agriculture/coffee

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**HUMBOLDT STATE UNIVERSITY**

Humboldt State University has been involved in studying coffee ecosystems in Jamaica for over 15 years. More information can be found at www.humboldt.edu/wildlife/faculty/johnson/research_jamaica.html

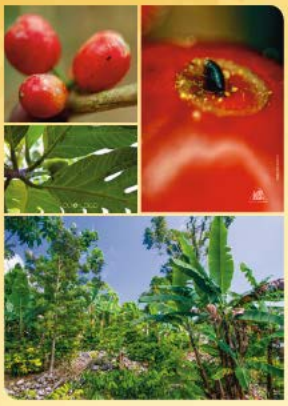
All photographs used by permission. Special thanks to Coffee Industry Board for coordination, Wendy Willis for photos, and Shawn Gould for the illustration. Funding provided by the Critical Ecosystem Partnership Fund.

# SHADE TREES FOR JAMAICAN COFFEE

**Benefits and Choices in Shade Tree Management**

## HOW CAN SHADE TREES ATTRACT BIRDS THAT WILL EAT PESTS AND BOOST FARM INCOME?

Recent research shows that birds can reduce damage by coffee berry borer by 50% in Jamaica. By controlling pests, birds can increase berry production and can boost farmer income by over $750 US per acre.



## WHICH SHADE TREES ARE BEST IN JAMAICA?

**TREES THAT INCREASE SOIL FERTILITY**

- Inga *(Inga vera)*
- Guango *(Samanea saman)*
- Quick stick *(Gliricia sepium)*
- Lead tree *(Leucaena leucocephala)*

**FRUIT & TIMBER TREES**

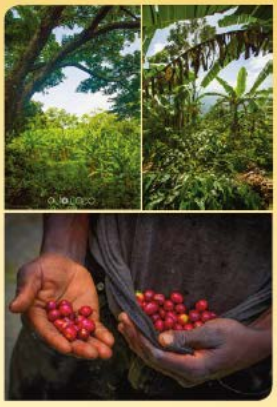
- Cedar *(Cedrela odorata)*
- Mahogany *(Swietenia mahagoni)*
- Broadleaf *(Terminalia latifolia)*
- Mango *(Mangifera indica)*
- Breadfruit *(Artocarpus altilis)*
- Banana *(Musa sp.)*
- Star apple *(Chrysophyllum cainito)*

**TREES ESPECIALLY ATTRACTIVE TO INSECT-EATING BIRDS**

- Inga *(Inga vera)*
- Guango *(Samanea saman)*
- Quick stick *(Gliricia sepium)*
- Star apple *(Chrysophyllum cainito)*
- Figs *(Ficus sp.)*

## HOW MUCH SHADE IS BEST?

Optimal shade conditions depend on elevation, local climate, and soil conditions. On poor soils in western Parishes, up to 50% shade (up to 40 trees per acre) is best. On good soils and/or in places with extensive cloud cover, 20-50% shade is best (10-40 trees per acre). Too much shade may increase the likelihood of fungal pests or reduce crop yield, but moderate amounts of shade increase crop production, help maintain soil fertility, increase farm longevity, and reduce pests.



Appendix C. Final report to CIB and RADA.

# Final Report to Jamaica's Coffee Industry Board and Rural Agricultural Development Agency on Dr. Matt Johnson's research and dissemination of the value of trees and insect-eating birds to coffee farmers near the Cockpit Country.

This project was funded by the Critical Ecosystem Partnership Fund (CEPF), for $19645, and ran from 30 April 2013 to 31 December 2013. The project partnered with the Coffee Industry Board, with Mr. Gusland McCook as the lead partner. CIB assisted with the identification of focal farms in the Catadupa and western/northern edge of the Cockpit Country for the field research phase. In addition, CIB was instrumental in coordinating the workshop described below.

This project had three phases: (1) field research, (2) analyses, and (3) dissemination. Field research occurred in summer (2013), when coffee fruits were ripening and vulnerable to the coffee berry borer, *Hypothenemus hampei*, the world's most economically damaging pest in coffee. Using the Jamaican Coffee Industry Board's database of coffee farms, we identified farms near Catadupa and the western or northern edge of the Cockpit Country. We visited each farm to document the diversity of shade trees growing over coffee. In the morning hours (sunrise to 10:00) we performed 20-min 'focal observations' on individual shade trees, at least 5 per common tree species on each farm. During the observations, we recorded foraging birds following established protocols. Field work was conducted by M. Johnson and his students.

Analyses occurred in fall and winter 2013. We documented 36 forest-associated bird species that benefit from shade trees grown on coffee farms near the Cockpit Country of Jamaica (Appendix A). Statistical analyses of bird use of shade tree species revealed which trees are most effective at harboring insect-eating birds likely to provision pest control services. We found that *Inga vera* and *Gliricidia* sp. were especially good and hosting insectivorous bird species. Using existing mathematical models (Railsback and Johnson 2011), we converted bird foraging activity into potential economic gain using typical crop yields and the most current crop prices available from the Coffee Industry Board. In addition, we used established relationships between proximity to forest habitats and the provisioning of pest control services (Jirinec et al. 2011) to reveal how the surrounding landscape (forest and patches of trees) contributes to the delivery pest control. This work was recently published in the Proceedings of the National Academy of Sciences (Railsback and Johnson 2014).

Dissemination of this work was accomplished in collaboration with the Coffee Industry Board (CIB) with a workshop (November) held in Cambridge Jamaica. The workshop was advertised and promoted by CIB and was well attended, with over 30 persons in attendance. There were multiple presentations (from CIB and Johnson) on the value of shade trees, followed by a round table discussion of the issues farmers face in choosing, maintaining, and managing coffee with shade in the Cockpit Country. A full-color informational brochure (trifold) was made available free to all attendees.

The project yielded several important results/impacts. First, we quantified the value of existing forests and trees in delivering ecosystem services. More specifically, we learned that shade trees attract insect-eating birds that consume coffee berry borer to an extent that offset the loss

of raw yields from enhanced shade. In the absence of the shade coffee, small patches of trees on the landscape (5%) maximize profits and, again, offset any loss in revenue from less area under cultivation. These findings are detailed in Railsback and Johnson (2014), a recent paper that has been picked up by the press (http://news.sciencemag.org/environment/2014/04/scienceshot-more-trees-more-coffee#disqus_thread; and http://www.abc.net.au/science/articles/2014/04/08/3977714.htm). Second, our bird foraging observation revealed that leguminous trees, especially *Inga vera* and *Gliricidia sp*., are among the most effective at attracting insect-eating birds to coffee farms. Third, we offered a workshop in November to disseminate this information specifically to farmers in the project area, and we learned from them about some of the constraints for growing shade trees. Fourth, we produced a full-color flyer that was disseminated to all participants of the workshop, as well as other farmers (Appendix B).

The project led to several recommendations. First, most farmers in the Cockpit Country already use shade, and generally have some appreciation for its value, but many of them know very little about the benefits of shade in terms of attracting insect-eating birds, pollinating bees, soil nutrients (e.g., in the case of leguminous shade trees), curtailing soil erosion, and the more general benefits of carbon sequestration. In short, they do not fully recognize the myriad ecosystem services these trees provide. CIB, RADA, the Ministry of Forestry and others should help ensure these benefits are recognized, so as to better incentivize the conservation of trees that benefit farmers, their communities, local biodiversity, and society in general. Second, some farmers want more shade trees, but lack resources to secure them. Policy makers and practitioners should work to make sapling shade trees, especially of favored species, more available to farmers. For example, coffee nurseries should offer shade tree saplings. From our work, especially useful trees are those that simultaneously fix nitrogen, attract birds and bees, sequester carbon, and provide some potential for later timber harvest (or other cash benefit, such as fruit or forage). Guango, Inga, Gliricidia, and Cedar are especially attractive for these multiple purposes. Third, the Coffee Industry Board should encourage the marketing of "shade-coffee" from this region. Although coffee from the Blue Mts enjoys a price premium without relying on recognition of the presence of shade trees, coffee from near the Cockpit Country does not have this taste reputation and sells at a more modest price. Coffee industries and farmers throughout the world have benefited from marketing their coffees as being shade-grown, and to date, little of this type of coffee is available from the Caribbean. The coffee industry in the Cockpit Country should be encouraged to maintain adequate shade coffee to benefits farmers, the soil, and the birds, merit certification, and fetch higher prices accordingly.

## Key Literature


Jirinec. V. B.R. Campos, M.D. Johnson. 2011. Roosting behavior of a migratory songbird on Jamaican coffee farms: Implications for ecosystem services. *Bird Conservation International* 21: 353-361.

Johnson, M.D., J.L. Kellermann, and A.M. Stercho. 2010. Pest control services by birds in shade and sun coffee in Jamaica. *Animal Conservation* 13: 140-147.

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Railsback, S.F., and M.D. Johnson. 2011. Pattern-oriented modeling of bird foraging and pest control in coffee farms. *Ecological Modelling* 222: 3305-3319.