

The Rufford Small Grants Foundation Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

| Grant Recipient Details | |
|----------------------------|---|
| Your name | Pedro López Del Castillo |
| Project title | Watershed Conservation in Cuba: Bio-monitoring, Training and Environmental Education III |
| RSG reference | 15916-B |
| Reporting period | Whole study (18 months) |
| Amount of grant | £ 10 000 |
| Your email address | pdelcastillo@nauta.cu & ffturquino@enet.cu |
| Date of this report | March th 3, 2016 |

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

| Objective | Not achieved | Partially achieved | Fully achieved | Comments |
|---|--------------|--------------------|----------------|--|
| Bio-monitoring | | ✓ | | These activities will have complete results in the long-term (In a Book). We will keep this objective in the next stages of our mission. |
| Environmental Education | | | ✓ | |
| Training to the Head Office of Protected Areas, Coffee Enterprises and Farmers | | | ✓ | |
| To Increase the forest cover by sub-basing. | | | ✓ | |
| To increase the Collection of Freshwater Fauna in Museum of Natural History Tomás Romay | | | ✓ | |

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

It is no relevant.

3. Briefly describe the three most important outcomes of your project.

Bio-monitoring (Appendix 1)

We are still working in the relationship between aquatic insects and water quality, in this opportunity to family level using the BMWP-Cub, the results were satisfactory, with a validation of the Index that shows us how with the increasing of stressing variables in the watershed the Index value decreases and vice versa. We have obtained the highest value in the head streams without strong anthropogenic influence, as well as, new data for different sample points inside of Sierra Maestra Mountain Range (SMMR), so increasing the base-line of knowledge on this topic. We keep the increasing of the collection of Freshwater Fauna with new registers for several species.

Environmental Education and Training. (Appendix 2)

We carried out similar activities like the previous stages of the project, which also included paintings and theater competitions among primary schools students but now reaching other communities through the project divided geographically in:

North hill side (Los Lajales, La Platica, Santo Domingo, Las Vegas and Montería) and South hill side (Palma Mocha, Las Cuevas and La Plata).

Talks were related to knowledge of species of the Flora and Fauna of each community and the relations of stressor factors with the environment. Protection of soil, forests, the importance of recycle of domestic materials of daily use, and change of aptitude with the rivers and streams.

In this stage we were working too in training according to the needs of conservation in every Protected Areas with the objectives of mitigating the stressing factors, mainly directed and oriented to Flora and Fauna Enterprise, Coffee Enterprise, Forestry Service and Farmers.

Reforestation Activities. (Appendix 3)

We are very satisfied with these activities because near 100 ha of forest was restored with endemics species of Cuban flora, the nurseries were very well accepted in communities and institutions. The Institution (Flora and Fauna Enterprise and Coffee Enterprise) were more responsible in maintaining the nurseries than schools and farmers. We planted mainly near the banks streams and abandoned crop areas. The main species was *Pinus maestrensis* (Endemic of Sierra Maestra Massif Range), *Magnolia cubensis* (Endemic and threated specie, distributed on massif ranges of Cuba), *Talauma orbicularis* (Endemic and threated specie, distributed on massif ranges of Cuba) and *Hibiscus elatus* specie with economical interest due to the wood.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

The communities involved in the Project (previously mentioned) have greatly participated, like critical objective of our activities example: in the cleaning of rivers, planted trees along of river banks and abandoned crop areas, developed talks, made painting expositions with issues related to conservation of watersheds and biodiversity from schools children to housewife.

The main benefit of the communities has been the increasing of awareness and knowledge referred to conservation of biodiversity.

The communities have also benefitted with better agriculture practice to protect the soil, a healthier practice of burning to do the smallholding, coffee grower diminished the application of pesticide and fertilizer and the most important benefit achieved by the communities is to contribute to a better life style inside the communities involved in the project.

5. Are there any plans to continue this work?

Yes. After these fruitful work and personal experiences with three stages of Rufford Foundation, we are planning to continue increasing our missions (in space and time)

as well as to carry out new conservation actions in long-lasting term in other watersheds of Cuba.

We will keep the objectives and tasks of this project related with Watersheds Conservation specifically on Training and Environmental Education, Biomonitoring and we will increase our footprint with useful actions that is the Forest Enrichment; if a second Rufford Booster Grant it is approved.

6. How do you plan to share the results of your work with others?

Our results and experience of this project has been share in two ways, first applied with the actualization of Management and Operatives plans of Turquino and Bayamesa National Parks (Appendix 6). I am another member of the conservation team to update these documents since 2001, for this reason criteria about conservation actions to mitigate stressing situation in protected areas become reality (example: the areas to clear-cut of exotic species, the enrichment of forest by sub watersheds, the selection of species to nursery. On the other hand, results have been presented in: The International Conference on Ephemeroptera and Plecoptera. Aberdeen 31 May - 5 June 2015 (Appendix 5)

Finally we have the book of conservation printed and I distributed in main Cuban research institution and it is available on: (Appendix 4) https://www.imta.gob.mx/biblioteca/libros/conservacion_y_uso_de_los_macroinvertebrados_dulceacuicolas.pdf

We are already preparing new papers concerning with Biomonitoring and Conservation of Watershed to publish.

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

The Booster Grant was approved to 10 July 2014; we have conceived it in 18 months to project to finish it in January 2016. We have been late due to the rainy season on forestry campaign activities.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

| Item | Budgeted Amount | Actual Amount | Difference | Comments |
|--|-----------------|---------------|------------|----------|
| Laptop | 500 | | | |
| Microscopy Stereoscopic | 500 | | | |
| Allowance to identify specimens | 700 | | | |
| Theater materials (Sheets, tempera, papers. Etc.) | 1000 | | | |
| Environmental Education Materials (Watercolors, color pencils, wax crayon, | 1200 | | | |

| | | | | |
|---------------------------------------|-------|--|--|--|
| books to presents. Etc.) | | | | |
| Working materials | 1500 | | | |
| Printing services | 500 | | | |
| Shipping cost | 300 | | | |
| Internet and communication | 400 | | | |
| Transport to field areas | 2000 | | | |
| Food for worker and snack to students | 1400 | | | |
| TOTAL | 10000 | | | |

9. Looking ahead, what do you feel are the important next steps?

Our team believes the mains steps are to continue the actions of conservation on Cuban Watersheds. For example:

- ✓ To continue increasing the activities related with, Biomonitoring, Training and Environmental Education in other watersheds of Cuba with an Ecosystem Approach applying the experience acquired and the methodology that has proved to work well in the current and previous projects.
- ✓ To increase the forest areas of the poor sub-basins through enrichment of the forest with their own endemic and threatened species in each locality. For this we will make several nursery seeds in every Watershed.
- ✓ To follow-up the processing of the data and to publish its results in scientific and popular magazines, as well as we are planning to work in our Cuban Book related with all these results (Taxonomy of main group, use of macroinvertebrate in Biomonitoring and the experiences on watershed conservation relating the social factors, watershed health and training and building)
- ✓ To share the results in meetings and workshops.
- ✓ To continue the researches referred to Bio-monitoring, Systematic and Ecology of Freshwater Fauna and their applicability into conservation of watersheds.
- ✓ To create an Internet website referred to Watershed Conservation for screening all tasks and experiences carried out.
- ✓ To secure that the updated information referred to Watershed Conservation be applied in the Protected Areas to update its Management Plans. For this we will to continue working with the heads of Protected Areas in charge of conservation.
- ✓ To apply for a second Booster Grant stage of Rufford to widen the activities in Watersheds Conservation in all Sierra Cristal Mountain Range. These actions and tasks will be assumed with an Ecosystem Approach, this means that we will be greatly focused in reaching results in a long-term.

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Naturally, in this third stage the RSGF logo was included in all our presentations (e.g. meetings and workshops), as well as in all lectures and talks in schools, communities inside of SMMR, Coffee Enterprises and Flora and Fauna Enterprise.

11. Any other comments?

We are very thankful to Rufford Foundation for all the support, allowing us to increase the actions for the watershed conservation in Cuba

Appendix 1: Results of Biomonitoring on San Juan watershed (Eastern of Sierra Maestra), To the End of table the values of BMWP-Cub.

| Class | Orders | Families | Rainy Season 10 to 14 June 2013 | | | | | Dry Season 17 to 20 April 2014 | | | | | Rainy Season 4 al 8 to August 2014 | | | | | Dry Season 2 to 6 March 2015 | | | | |
|----------------|------------------|-------------------|------------------------------------|-----|-----|-----|-----|-----------------------------------|-----|-----|-----|-----|---------------------------------------|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|
| | | | p1 | p2 | p4 | p5 | p7 | p1 | p2 | p4 | p5 | p7 | p1 | p2 | p4 | p5 | p7 | p1 | p2 | p4 | p5 | p7 |
| Turbelaria | Tricladida | Dugesidae | | | --- | | | | | --- | --- | | | | | --- | | | | | | |
| Clitellata | Haplotaxida | Lumbricidae* | --- | | | | | | | | | | | | | | | | | | | |
| Hirudinea | Gnathobdellida | Glossiphoniidae | | | | --- | --- | | | | --- | | | | | | --- | | --- | | --- | |
| Arachnida | Trombidiformes | Hydrachnidae | --- | | | | | | | | | | | | | | | | | | | |
| Ostracoda | Podocopida | Cyprididae?* | | | | | --- | | | | | | | | | | | | --- | | --- | |
| Malacostraca | Decapoda | Pseudotelphusidae | | | | | | | | | | | | | | | | | | --- | | |
| Entognatha | Entomobryomorpha | Entomobryidae* | | | | --- | | | | | | | | | | | | | | | | |
| Insecta | Odonata | Libellulidae | --- | --- | --- | | | --- | --- | | | | --- | --- | | | | --- | --- | --- | --- | --- |
| | | Gomphidae | | | | | | --- | | | | | --- | | | | | | --- | | | |
| | | Protoneuridae | --- | | --- | --- | --- | --- | | | --- | | | --- | | | | --- | --- | --- | | |
| | | Lestidae | | | --- | --- | --- | | | | | | | | | | | | | | | |
| | | Caenagrionidae | | | | | | | | | | | | | --- | | | | | | | --- |
| | Ephemeroptera | Baetidae | | --- | --- | --- | | --- | --- | --- | --- | --- | --- | --- | --- | | --- | --- | --- | --- | --- | --- |
| | | Leptophlebiidae | | | | | | | | | | | | --- | | | | --- | | | | |
| | | Leptohyphidae | --- | --- | | | | --- | | | | | --- | --- | | | | --- | --- | | | |
| | | Caenidae | | --- | | | | | --- | | | | --- | | | | | | --- | --- | | |
| | Hemiptera | Corixidae | | | | | | | | | | | | | | | | | | | | --- |
| | | Hebridae* | | | | | | | | | | | | | | | | | --- | --- | | --- |
| | | Veliidae | | | | | | | --- | | | | | | | | | --- | --- | | | |
| | | Belostomatidae | | | | | --- | --- | | | | | | | | | | --- | | | --- | --- |
| | Trichoptera | Glossosomatidae | --- | | --- | | | | | --- | | | | --- | --- | | | | | | | |
| | | Philopotamidae | | | | | | | | | | | | --- | | | | | | --- | | |
| | | Calamoceratidae | | | | | | | --- | | | | | --- | | | | | --- | | | |
| Hydropsychidae | | --- | --- | | | | --- | --- | --- | | | --- | --- | --- | | | --- | --- | --- | --- | | |
| | | Hydroptilidae | --- | --- | | | | --- | | | | | | | | | | | | --- | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|------------|---------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | Helicopsychidae | --- | --- | | | | | --- | --- | --- | | | | | --- | --- | | | | | |
| | | Xiphocentronidae | | | | | | | | | | | --- | | | | | | | | | |
| | Coleoptera | Hydrophilidae | --- | --- | | | | | --- | --- | | | | | | | | | | | | |
| | | Limnephilidae* | --- | | | | | | | | | | | | | | | | | | | |
| | | Lymneidae* | --- | | | | | | | | | | | | | | | | | | | |
| | | Staphylinidae* | | --- | | | | | | | | | | | | | | | | | | |
| | Lepidoptera | Crambidae | | | --- | | | | | --- | | --- | --- | | | | | | | --- | | |
| | | Dixidae | | | | | | | --- | | | | | | | | | | | --- | | |
| | Diptera | Empididae | | | | | | | | | | | | | | | | | | | | |
| | | Ephydriidae | --- | | | | | | | | | | | | | | | | | | | |
| | | Ceratopogonidae | | | | | | | | | | | | | | | | | | | --- | |
| | | Culicidae | | | | | | | --- | | | | | | | | | | | | | |
| | | Chironomidae | --- | --- | --- | --- | --- | | --- | --- | | | | | | --- | --- | --- | --- | --- | --- | |
| | | Psychodidae | --- | --- | | | | | | | | | | | | | | | | | | |
| | | Simuliidae | | --- | | | | | --- | --- | | | | | | | | | | | --- | |
| | | Stratiomyidae | --- | --- | | | | | --- | | | | | | | | | | | | --- | |
| | Tabanidae | | --- | | | | | | | | | | | | | | | | | | | |
| Gastropoda | Prosobranchia | Hydrobiidae* | --- | --- | --- | | | | | | | | | | | | | | | | | |
| | | Thiaridae | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| | Pulmonata | Physidae* | | | | | | | | | | | | | | | | | | | --- | |
| | | Planorbidae* | | | | | | | | | | | | | | | | | | | | --- |
| Bivalvia | Veneroida | Corbicullidae* | | | | | | | | | | | | | | | | | | --- | | |
| | | BMWP-Cub | 81 | 78 | 49 | 26 | 25 | 73 | 65 | 67 | 22 | 27 | 66 | 75 | 35 | 14 | 11 | 65 | 83 | 53 | 36 | 18 |

* Families without Tolerance Values.

Appendix 2. Training and building.



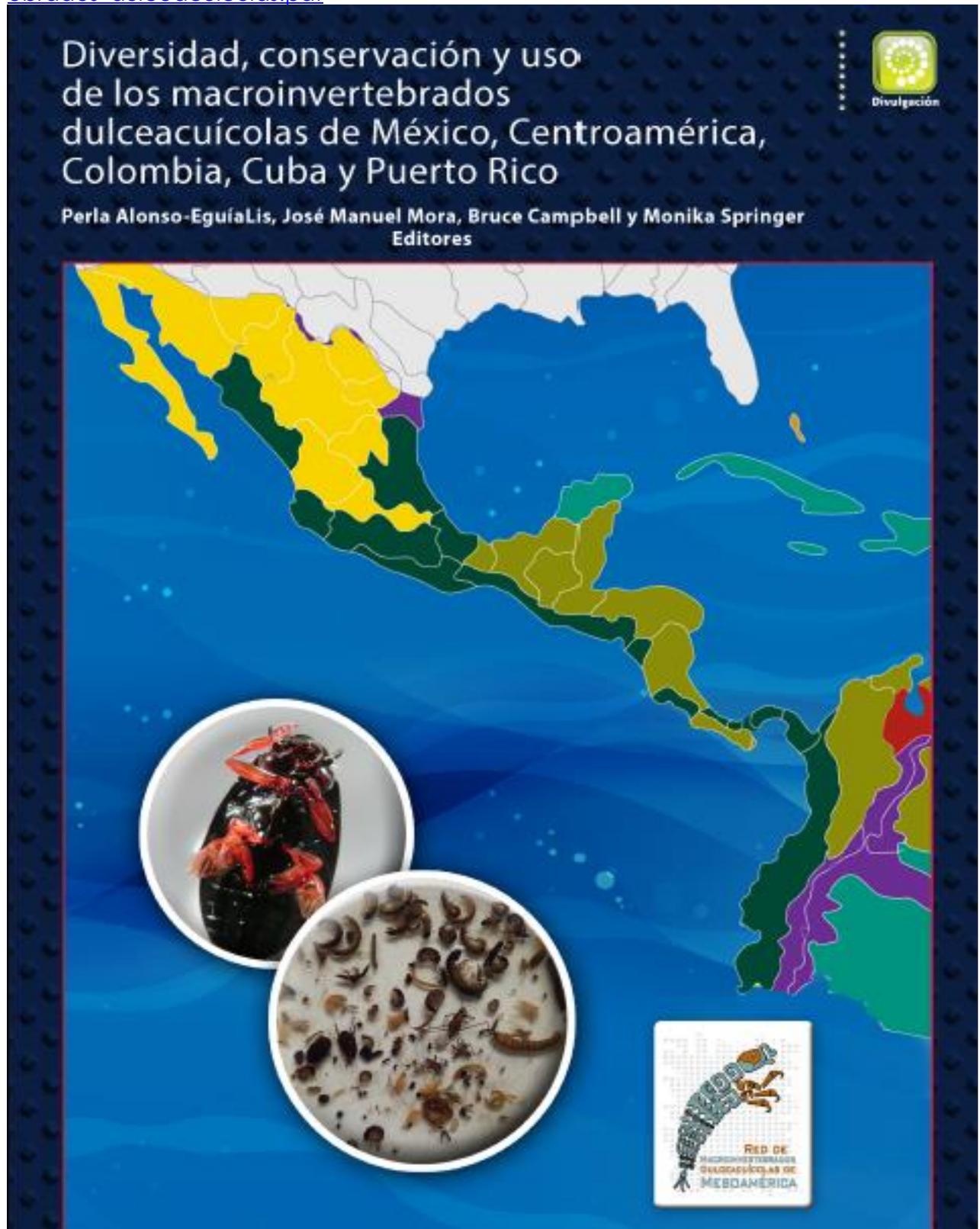
Appendix 3. Reforestation Activities.





Appendix 4. Finally the book is printed.

https://www.imta.gob.mx/biblioteca/libros/conservacion_y_uso_de_los_macroinvertebrados_dulceacuicolas.pdf



Appendix 5. Poster presented in The International Conference on Ephemeroptera and Plecoptera. Aberdeen 31 May - 5 June 2015



Structure, Abundance and Microhabitats of Mayfly Communities (Ephemeroptera) in the Nagua River Watershed, Cuba

Pedro López Del Castillo¹ and Janice G. Peters²

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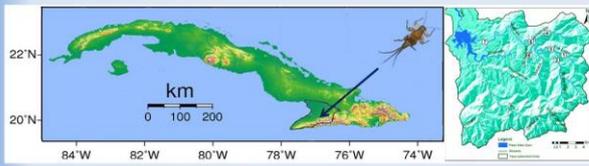
ABSTRACT. The structure, abundance and microhabitat of mayflies (Ephemeroptera) were studied in the Nagua Watershed, Granma Province, Cuba, a tributary of the Yara River located on the northern slopes of the Sierra Maestra Mountain Range. The watershed is characterized by 2nd growth forest, coffee plantations, cultivated banana, and cultivated and weedy malanga (*Xanthosoma*). Such agricultural uses seriously reduce canopy cover by deforestation and increase sedimentation and erosion. We sampled five microhabitats (stones in current, stones in pools, sand, leaf litter and marginal vegetation) at four tributary stations and three stations of the main river during the dry and rainy seasons (March and November 2010), for a total of 5491 specimens representing 4 families, 11 genera and 19 species. New records for the region include *Paracloodes lilliputian*, *Poecilophlebia paco*, and *Americabaetis naranjoi*. The most abundant species were *Falceon planifrons* (29.14%), *Tricorythodes sacculobranchis* (16.81%), *Falceon nikitai* (16.1%) and *Careospina hespera sierramaestrae* (12.1%). The microhabitat "stones in current" had greater diversity and abundance than did other microhabitats, but several species were associated with a specific microhabitat, for example *Caenis cubensis* with leaves, *Cloedes superior* with sand, *Tricorythodes montanus* in submerged bank vegetation and *Falceon planifrons* in riffles. These results contribute to baseline knowledge as part of a long-term project concerned with environmental health, biomonitoring, education and watershed conservation in this most important biodiversity site in the West Indies.

Cuba is largest of the Caribbean Islands – a biodiversity hotspot

- Cuba is biologically diverse, with high number of endemic species, and 263 natural protected areas covering nearly 22% of territory [National Geographic 2003]
- Sierra Maestra is the largest mountain range in Cuba, with highest peaks, protected areas, and Turquino National Park; Nagua River Watershed is on the northern slope
- Nagua Watershed with 2nd growth forest, coffee and banana plantations, introduced weeds, and clear-cut agriculture (deforestation, increased sedimentation, erosion)
- Projects to study biodiversity, prevent habitat loss, and provide environmental education
- Results presented here for freshwater biodiversity of mayflies (Ephemeroptera) in the Nagua River and its tributaries



Figures 1-3: 1, Deforestation. 2, Headwaters of Nagua River. 3, Environmental education.



Figures 4-5: 4, Cuba, with outline of Granma Province; arrow indicates study region. 5, Study sites (numbered) in Nagua Watershed, the northern division of Yara Watershed, and outside protected Turquino National Park.

Table 1. Percent (%) representation of species and families collected. * = endemics; ** = new locality record.

| Species | Rainy | Dry | Total | |
|--|----------------|-------|-------|-------|
| 1 <i>Falceon planifrons</i> | 35.8 | 22.1 | 29.1 | |
| 2 <i>Tricorythodes sacculobranchis</i> * | 10.0 | 24.0 | 16.8 | |
| 3 <i>Falceon nikitai</i> | 22.4 | 9.4 | 16.1 | |
| 4 <i>Careospina h. sierramaestrae</i> * | 15.1 | 9.0 | 12.1 | |
| 5 <i>Hagenulus morrissonae</i> * | 1.9 | 19.2 | 10.3 | |
| 6 <i>Falceon alcarrazae</i> * | 1.3 | 9.4 | 5.2 | |
| 7 <i>Tricorythodes cubensis</i> * | 5.2 | 1.7 | 3.5 | |
| 8 <i>Paracloodes lilliputian</i> **, ** | 2.2 | 0.2 | 1.3 | |
| 9 <i>Careospina baconaai</i> **, ** | 1.5 | 0.9 | 1.2 | |
| 10 <i>Farrades bimaculatus</i> * | 0.7 | 1.3 | 1.0 | |
| 11 <i>Caenis cubensis</i> * | 1.1 | 0.8 | 0.9 | |
| 12 <i>Tricorythodes gallator</i> * | 1.2 | 0.3 | 0.8 | |
| 13 <i>Cloedes inferior</i> | 0.4 | 0.6 | 0.5 | |
| 14 <i>Cloedes superior</i> | 0.4 | 0.2 | 0.3 | |
| 15 <i>Traverina oriente</i> **, ** | 0.0 | 0.6 | 0.3 | |
| 16 <i>Falceon longifolius</i> | 0.4 | 0.1 | 0.2 | |
| 17 <i>Tricorythodes montanus</i> * | 0.1 | 0.2 | 0.2 | |
| 18 <i>Americabaetis naranjoi</i> ***, ** | 0.2 | 0.0 | 0.1 | |
| 19 <i>Poecilophlebia paco</i> **, ** | 0.1 | 0.0 | 0.1 | |
| Family | total numbers: | 2,664 | 2,827 | 5,491 |
| Family Baetidae | | 63.0 | 42.0 | 52.8 |
| Family Leptophlebiidae | | 19.3 | 30.9 | 25.0 |
| Family Leptohyphidae | | 16.6 | 26.3 | 21.3 |
| Family Caenidae | | 1.1 | 0.8 | 0.9 |

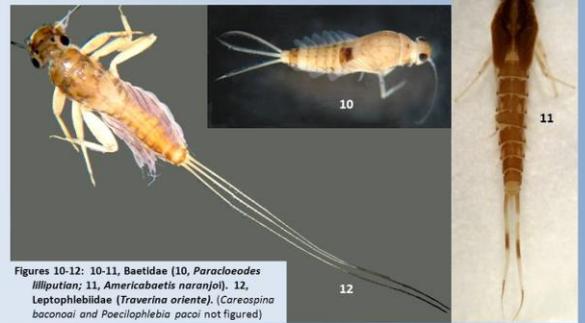
In 2010, the Nagua Watershed was sampled in the rainy (November) and dry (March) seasons; 19 species and 5491 specimens were collected

- Many common, widely distributed species: *Falceon planifrons*, *Tricorythodes sacculobranchis*, most Leptohyphidae, and *Caenis cubensis*
- Falceon alcarrazae* was well represented although previously thought to be rare



Figures 6-9: 6, *Falceon planifrons*. 7, *Falceon alcarrazae*. 8, *Tricorythodes gallator*. 9, *Caenis cubensis*.

New distribution records: rare and endemic species *Paracloodes lilliputian*, *Americabaetis naranjoi*, *Traverina oriente*, *Careospina baconaai*, and *Poecilophlebia paco*



Figures 10-12: 10-11, Baetidae (10, *Paracloodes lilliputian*; 11, *Americabaetis naranjoi*). 12, Leptophlebiidae (*Traverina oriente*). (*Careospina baconaai* and *Poecilophlebia paco* not figured)

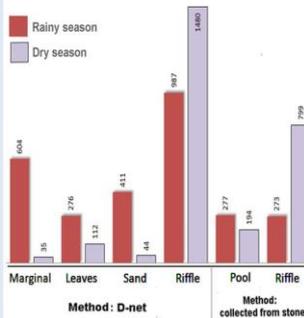


Figure 13: Total numbers of Ephemeroptera collected in rainy (November) and dry (March) seasons, by habitat and collecting method. D-net a 30 cm square sample repeated 3 times; "collected from stones" indicates specimens hand-collected from 15 stones at each site.

Using methods summarized in Fig. 13:

- Baetidae dominant in both seasons but more abundant in rainy season; *Falceon alcarrazae* an exception
- Leptophlebiidae and Leptohyphidae more often collected in dry season
- Abundance in riffle habitats in dry season may reflect reduction of other habitats; more species collected on stones in sand during rainy season

Table 2. Total number of species collected from each habitat (methods as in Fig. 13).

| Method | Habitat | Total | |
|-----------------------|----------|-------|-----|
| | | Rainy | Dry |
| D-net | Marginal | 9 | 9 |
| | Leaves | 12 | 10 |
| | Sand | 14 | 7 |
| | Riffle | 8 | 9 |
| collected from stones | Pool | 12 | 8 |
| | Riffle | 6 | 9 |

Some clear associations of species with habitats:

- Cloedes superior* in sand
- Falceon planifrons* in riffles
- Caenis cubensis* in leaves
- Tricorythodes montanus* in marginal vegetation



Figure 14: *Cloedes superior*.

Data analysis, research, community outreach and conservation activities continuing

Acknowledgments



The authors gratefully acknowledge the Rufford Foundation for support of projects concerned with Watershed Conservation and Biomonitoring in Cuba. In addition we acknowledge the ongoing support of BIOECO (Santiago de Cuba) and Florida A&M University (Tallahassee) and especially the advice and leadership of our late colleague Dr. Carlos Naranjo López.



Appendix 6. Workshop to update the Management Plan of Turquino National Park. From left to right Pedro López Del Castillo, Pedro Hernández (Director of Conservation of Turquino Administration Unid), Adalenis (economist), Yulieski (Forestry Ing.), Niuris (Environmental Education specialist), Dariel (Forestry Ing.)

