

Castillo and her research team to organize, compile, and safeguard 30 years' worth of pesticide data from the Palo Verde wetlands by creating EDI files with the pesticide data and a wealth of metadata. *Dr. Luisa Castillo of the Universidad Nacional of Costa Rica is one of the world's leading tropical ecotoxicologists. As a professor and as the director of the Central American Institute of Studies on Toxic Substances (IRET), she worked on water quality in Costa Rica for more than 30 years with a team of colleagues, monitoring and assessing water quality (pesticides, antibiotics, invertebrate populations) around the country, including at the Palo Verde National Park. This work has focused on the impact of pesticides in rice, banana, pineapple, and other agricultural systems at the local stream level and at the larger watershed level.*

Data collection from Palo Verde occurred at 8-10 sites around the Palo Verde area during each of three different study periods: 1992-1994, 2001-2005, and 2009-2011. Some of the data were published in peer reviewed publications, technical reports, and in two Master's Degree theses (Chaverri et al 2000, Rizo-Patrón 2003), but other data are still unpublished. Luisa's team is currently contemplating a new round of water quality assessments, including the valuable addition of a microplastics component. In order to plan for the new research, they are preparing to compile all of the data across the sites and the three time periods, create land cover and land use maps for the study area, and evaluate sites for the next round of data collection.

The EDI Fellow would work in parallel with Luisa's team to create the EDI files. Silvia Echeverría-Sáenz, a Ph.D. student and researcher at IRET, would coordinate the mentor team for the EDI Fellow. See below for further details.

What is your current project?

Although wetland protection is mandatory in Costa Rica, its wetlands are increasingly under pressure from pesticides (herbicides, nematicides, insecticides) used in agriculture, including rice, bananas, and pineapples. In 2017 Costa Rica launched its National Wetlands Policy, proposing "measures to protect wetlands at risk and to rehabilitate those facing deterioration" (Tico Times 8 March 2017: <http://www.ramsar.org/news/costa-rica-pledges-to-improve-protection-of-its-wetlands>). And yet Costa Rica continues to have one of the highest pesticide uses in the world, based on cultivated land area <https://news.co.cr/costa-rica-takes-first-place-in-the-world-for-the-use-of-pesticides/72749/>.

Dr. Luisa Castillo's team and associates have published many papers on the effects of pesticides in Costa Rica's waterways (Bravo-Durán et al 2013, Castillo et al 2006, de la Cruz et al 2014, Echeverría-Sáenz et al 2012, Fournier et al 2018, Mena et al 2014, Rizo-Patrón et al 2013). Chemical analysis of water samples is combined with the determination of macroinvertebrate biodiversity and community structure, measures that have been shown to provide an index of ecosystem health (Arias-Andrés et al 2014). This team has also conducted analyses of Costa Rican citizens' perceptions of water resources and water availability (Madrigal-Solís et al 2020).

The full range of data available would be too unwieldy for an 8-week EDI Fellowship. Based on the recommendations of EDI data analysts, as well as the experience of the two EDI La Selva Fellows from 2020, we would select a manageable dataset for the EDI training period and then determine the outlines

of the project for the 8-week period. A reasonable plan would be to select one data collection period (e.g., dry season 1992), the eight sites, and the top ten most important chemicals tested. This could provide the structure for the data file. Then during the 8-week period (June-July 2021), the Fellow and the mentor team would decide how to work out from there. Add additional collection times? Add additional chemicals? Some of those decisions would be based on what metadata are easily accessible. Fortunately, the PIs for these projects are all still actively engaged in research so the metadata should be readily available, although new, updated maps may need to be created.



Río Cabuyo, Lomas Barbudal site, Palo Verde



Silvia Echeverría-Sáenz collecting water samples and macroinvertebrates in the Palo Verde area

Who would be the Fellow's advisor?

The Fellow would work with a mentor team consisting of the original P.I. for the water quality project (Dr. Luisa Castillo), a doctoral student at the Universidad Nacional (Silvia Echeverría-Sáenz), OTS scientific staff in Costa Rica (Enrique Castro, Juan Serrano), and OTS administrative staff (Elizabeth Braker, Deedra McClearn).

Who would be the on-site person (people) answering content-related science and technical questions and providing access to the data sets? Note: The Fellow does not have to be on-site for this project.

Luisa Castillo and Silvia Echeverría-Sáenz (for questions about the data and most metadata)
Juan Serrano, OTS, Palo Verde (for questions about the site and metadata related to GPS coordinates)
Enrique Castro, OTS, La Selva (for questions about OTS informatics and some satellite data)
Deedra McClearn and Beth Braker (for questions about OTS long-term legacy data program)

Will there be manual data entry involved?

Possibly. Most of the data will be in Excel spreadsheets but the Fellow would need to reconfigure data tables to comply with the EDI format.

How will the Fellow's work benefit the long-term data management strategy of your project / site / field station?

The Fellow's work will have a positive and important impact on long-term data management at three or more different levels:

1. Organization of 30 years of water quality data from a major tropical wetland; foundation for future pesticide and microplastic work at Palo Verde; presentation of the data to the scientific world in an EDI "FAIR" format.
2. Evidence-based input for management decisions across the entire watershed in collaboration with government, business, NGO, and community partners.
3. Advancement of OTS drive to rescue important long-term "legacy" datasets from the OTS sites.

See letter of support from Dr. William K. Michener, University of New Mexico, EPSCoR, ESA Data Papers.

Will the Fellow stay at your research site?

No, this work can be conducted entirely on-line in collaboration with the mentor team.

OTS Efforts at New Science / Management Paradigm

Paradoxically, the current constrained resources of OTS and of SINAC, as well as the severe challenges brought by the Covid pandemic, may actually aid in the evolution of a new partnership among OTS, SINAC, donors, and other stakeholders in the region. **Management of the iconic and precious Palo Verde / Tempisque Basin wetlands and watershed absolutely needs an integrated, cooperative, science- and stakeholder-based approach at this point in time. None of these entities can operate in isolation and we all have a core nucleus of common interests.**

Components of strategic management plan:

- OTS donor group, focused campaign, "Save the Wetlands" *
- new MOU between SINAC and OTS
- research-based decision making (hydrological cycles, remediation possibilities)

- other NGOs (Costa Rica para Siempre)
- Costa Rican government emphasis on water as a constitutional right
- natural history visitors from local hotels (source of revenues for Park and OTS)
- local rice growers and other agricultural interests (economic and environmental balance)
- community input (jobs, schools, economic equity, sustainable development, human health, One Health approach)

* With an initial donation to the OTS Palo Verde fund-raising campaign, OTS and its partners have been able to create some important forward momentum:

1. First Palo Verde Christmas Bird Count, accomplished on 22 December 2020
2. Research support for two Ph.D. students from University of Florida Water Institute for their field work on water resource management at Palo Verde from socioeconomic perspectives
3. Construction of an information kiosk (in conjunction with SINAC)
4. Support for Master's Degree student from UNA to work on data retrieval and coordination with the EDI Fellow

The goal is to use modest investments and focused projects as leverage to plan bigger projects and to secure larger donations.

The EDI Fellowship Award would be an important step in consolidating 30 years' worth of critical pesticide data, providing the foundation for the continuation of work on water quality in the Tempisque Watershed, and establishing the culture of responsible data management within OTS.

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