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RPPR Final Report

as of 14-Nov-2018

Agency Code:

Proposal Number: 64437LSMRI
INVESTIGATOR(S):

Agreement Number: W911NF-13-1-0281

Name: Jerome Dobson
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DUNS Number: 076248616

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Report Date: 31-Oct-2018

Date Received: 13-Nov-2018

Final Report for Period Beginning 01-Aug-2013 and Ending 31-Jul-2018

Title: The Human Geography of Resilience and Change: Land Rights and Political Stability in Latin American Indigenous Societies

Begin Performance Period: 01-Aug-2013

End Performance Period: 31-Jul-2018

Report Term: 0-Other

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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees:

STEM Participants:

Major Goals: Since 2013 KU Professors Jerry Dobson and Peter Herlihy and a small group of graduate students from the University of Kansas have led Centroamérica Indígena, a massive effort including collaborations with indigenous and state governments, and NGOs, to understand indigenous societies in Central America. Funded by a prestigious Minerva Grant for University-led Research from the Office of the Secretary of Defense and Army Research Office, they study the geographic factors that favor stability, instability, and resilience in indigenous municipalities throughout the seven countries of Central America. Most communities suffer similar stresses?social and political discrimination, land dispossession, extreme poverty, narco-trafficking, and violence. Yet, some communities are thriving, protecting lands, managing natural resources, and maintaining cultural identities while others are not. The project focuses on secure land ownership and territorial sovereignty as key variables to be tested.

The investigators seek to advance the geographic and cartographic base of information essential for governance, to improve cartographic methods and techniques, and to forge new frameworks for societal interaction among indigenous communities, organizations, and individuals. In partnership with many local, national, and international organizations, the team has mapped over 10,000 km² of the newly-established "indigenous territorial jurisdictions" that include the least known and most conflictive areas of Central America, producing an enormous and unprecedented Geographic Information System (GIS) database on the region's lands and peoples.

Their success story should be of interest to anyone in the intelligence, foreign policy, and military strategy communities. Participatory research mapping (PRM) maps land cheaper than ever before at finer resolutions and with pre-validation and pre-approval by the resident population, plus this innovative methodology educates and creates goodwill and lasting relationships that can serve whenever crises arise in the future. These benefits result from a cooperative exercise of inter-governmental and non-governmental organizations and broader use of PRM within the context of a unified regional GIS to address social and scientific research questions.

Accomplishments: a) Working with indigenous communities and their governing federations, as well as state organizations and NGOs in Central America, we have produced the precise large-scale cartographic information needed for the governance of their conflictive lands that experience drug-trafficking, land-grabbing, and mega-development pressures.

We published large-scale digital maps of:

1. eight new Concejos Territoriales (multi-village community-titled territory) in La Mosquitia, Honduras;
2. the Reserva Indígena Alto Chirripo in the Talamanca highlands, Costa Rica; and
3. the Department of Sacatepéquez in the highlands of Guatemala, made using participatory research mapping (PRM) with geographic information systems (GIS).

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See maps at http://prmapping.res.ku.edu/MASTA_CTs_ICP.html

b) We demonstrated the participatory research mapping-GIS (PRM-GIS) works well for producing and updating cartographic sheets abroad.

For example, in the Honduran Muskitia, our results in print and digital formats cover the area of 25 official 1:50,000 topographic sheets that had not been updated since first publishing in the 1960s or 1970s (when the National Geographic Institute (IGN) worked with the US Defense Mapping Agency (DMA) to do this expensive work).

c) We completed another PRM-GIS pilot study in the 750km² indigenous Cabécar territory of the Costa Rican Talamanca highlands. The cartographic results will be used by the governing indigenous authorities in developing their territory's first management plan for resource use and land tenure. The results include detailed large-scale maps with thousands of previously undocumented toponyms (place names) and land use locations, all generated and carefully verified by community-chosen local investigators and other community members.

d) We have developed an ArcGIS Database of variables related to the stability, resilience, and governances of all seven states in Central America, using the 1216 municipios (counties) as the unit of analysis. We first constructed an accurate map of these municipal polygons, to form the base units to query and analyze. We have about 40 different variables that we have finished populating the data in each of the 1216 municipios.

e) Since the project began in 2013, working with indigenous, university, state, and NGO collaborators, we have completed difficult field research in complicated and conflictive indigenous regions of Honduras, Costa Rica, and Guatemala, publishing new cartographic information of great detail and precision, while also plotting the settlements, land uses, land cover, and other culturally significant features.

f) We presented our cartographic results together with our indigenous collaborators to the Honduran government in a meeting with the Director of the RAN and also to INEGI in Costa Rica. In Honduras we collaborated directly with the Honduran World Bank Project PATH II.

g) As time-consuming participatory research mapping (PRM) field-based research and GIS database development has been completed, we are now publishing on a variety of different parts of the enormous original database created by the project.

Training Opportunities: Working directly with government agencies, universities, indigenous federations, and NGOs, we trained 11 professors, 1 post doctoral fellow, 4 graduate students, 9 undergraduate students, and 101 indigenous geographers to conduct and support participatory mapping of their own resources and boundaries. GIS technological and other geographic skills were transferred to the extent possible over the duration of the grants to indigenous and non-indigenous college-level students and "local geographers" that we trained in Honduras, Costa Rica, and Guatemala, through our multi-year participatory research mapping (PRM) and data collection activities.

We also developed an unrelated one-week intensive training course taught by John Kelly and Taylor Tappan for secondary school instructors in Choluteca, Honduras.

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Results Dissemination: a) Presentations

i) Presentations at meetings, but not published in Conference Proceedings (28):

1. Fahrenbruch, M.L. 2018. "Getting that Jellyfish Crunch": Sequential Exploitation, Cannonball Jellyfish, and the Global Jellyfish Market. Great Plains/Rocky Mountain AAG, Manhattan, Kansas. October 5-6, 2018.
2. Herlihy, P.H., M.L.Fahrenbruch, and T.A. Tappan. 2018. "Indigenous Territorial Jurisdictions and Forest Conservation in Central America." Great Plains/Rocky Mountain AAG, Manhattan, Kansas. October 5-6, 2018.
3. Fahrenbruch, M.L. 2018. Challenges to Demarginalization. The case of fisheries governance and the development of the export jellyfish fishery on the Miskito Coast of Nicaragua (Paper). International Geographical Union (IGU) in Quebec City, Canada. August 6-10, 2018.
4. Fahrenbruch, M.L. 2018. "Nobody ever came": Communal Governance and Jellyfish Fisheries in Post-Law 445, Nicaragua. Paper Presented at the 35th Conference of Latin Americanist Geographers in San Jose Costa Rica. May 20-22, 2018.
5. Herlihy, P. H. 2018. "Recognizing Indigenous Territories in Central America," Paper presented at the 35th Conference of Latin Americanist Geographers, San José, Costa Rica. May 22.
6. Tappan, T. A. 2018. "Constructing and Legitimizing Indigenous Miskitu Territory through 25 Years of Land and Resource Use Mapping." Conference of Latin Americanist Geographers. May 21-22, San José, Costa Rica.
7. Herlihy, Peter H., and Taylor A. Tappan. 2017. "Participatory Research Mapping in Alto Chirripó Indigenous Reserve." Invited presentation at the Instituto Geográfico Nacional, San José, Costa Rica. August 16.
8. Herlihy, Peter H., and Taylor A. Tappan. 2017. "Preliminary Results of Participatory Research Mapping Pilot Study in Costa Rican Talamanca." Invited presentation at School of Geography, University of Costa Rica, March 20th, San José, Costa Rica. March 20.
9. Herlihy, Peter H. and Taylor A. Tappan. 2017. "Preliminary Results of Participatory Research Mapping Pilot Study in Costa Rican Talamanca." Invited presentation at School of Geography, University of Costa Rica, San José, Costa Rica. 20 March.
10. Tappan, Taylor A. 2017. "Mapping Land Cover Change in Alto Chirripó, Costa Rica." Brownbag series presentation at Department of Geography and Atmospheric Science, University of Kansas, Lawrence, KS. 18 April.
11. Herlihy, Peter H. and Taylor A. Tappan. 2017. "Participatory Research Mapping in Alto Chirripó Indigenous Reserve." Invited presentation at Instituto Geográfico Nacional, San José, Costa Rica. 16 August.
12. Herlihy, P. H. 2016. "Indigenous Peoples and Forest Conservation in Central America." Geography 2050: Envisioning a Sustainable Planet, Columbia University, New York. 18 November. See <http://www.geography2050.info/>
13. Dobson, J. E. August 22, 2016, "Community-Based Mapping for Governance and Stability in Central America," U. S. Department of State, invited lecture sponsored by Bureau of Intelligence and Research (INR).
14. Tappan, T. A. 2016. "Desarrollando Información Geográfica de Base a través de las Investigaciones Cartográficas Participativas (ICP) en la Muskitia Hondureña." Food and Agricultural Organization (FAO) Mesoamerican Conference on Open Tenure. May 16-20. Sololá, Guatemala.
15. Tappan, T. A., P. H. Herlihy, A. R. Viera, M. L. Fahrenbruch, and J. E. Dobson. 2016. "Developing Baseline Geographic Information through Participatory Research Mapping in Alto Chirripó Indigenous Reserve, Costa Rica." Association of American Geographers conference. March 29-April 1. San Francisco, CA.
16. Ramos, A., P.H. Herlihy, T.A. Tappan, and J.E. Dobson. 2016. "Participatory Research Mapping (PRM) in Sacatepéquez, Guatemala. Municipios and Tierras Comunales." Conference of the Association of American Geographers, San Francisco, CA. March 29.
17. Dobson, Jerome E., Peter H. Herlihy, Taylor A. Tappan (presenter), Matthew L. Fahrenbruch, and Aida Ramos Viera. 2015. "Land Rights and Stability in Indigenous Societies of Central America." Minerva Meeting and Program Review Conference, Washington, D.C. September 9-10.
18. Tappan, Taylor A., Peter H. Herlihy, Aida Ramos Viera, Mathew L. Fahrenbruch, and Jerome E. Dobson. 2016. "Developing Baseline Geographic Information through Participatory Research Mapping in Alto Chirripó Indigenous Reserve, Costa Rica." Association of American Geographers annual conference, San Francisco, California. March 29.
19. Fahrenbruch, M.L., P.H. Herlihy, T.A. Tappan, A. Ramos, J.H. Kelly, and J.E. Dobson. 2016. Participatory Research Mapping in the Concejos Territoriales of the Honduran Muskitia: Observations on Changing Resource Use Patterns. Conference of the Association of American Geographers, San Francisco, CA. March 29.
20. Herlihy, Peter H., Edgardo Benítez Maclin, and Taylor A. Tappan. 2015. "Biosphere Reserves are Not Enough: Protecting Indigenous Tawahka Lands and Peoples in the Honduran Muskitia." International Conference of Latin Americanist Geographers (CLAG), Fortaleza, Brazil. May 27.
21. Herlihy, Peter H., Taylor A. Tappan (presenter), Matthew L. Fahrenbruch, John H. Kelly, and Jerome E. Dobson. 2015. "Establishing a New Indigenous Territory for the Miskitu in Honduras." Conference of Latin Americanist Geographers. Fortaleza, Brazil. May 26-30.

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22. Herlihy, Peter H., Taylor A. Tappan, and Donaldo Allen. 2015. "La Investigación Cartográfica Participativa (ICP) en América Central y Honduras." Instituto Geográfico Nacional (IGN), with municipal leaders from the Department of Sacatepéquez, Antigua, Guatemala. May 11.
23. Herlihy, Peter H., Taylor A. Tappan, and Donaldo Allen. 2015. "La Investigación Cartográfica Participativa (ICP) de las tierras indígenas de La Moskitia, Honduras." Alto Chirripó Indigenous Cabécar Territory Commission, Grano de Oro, Talamanca, Costa Rica. May 9.
24. Herlihy, Peter H., Taylor A. Tappan, and Donaldo Allen. 2015. "Las investigaciones cartográficas participativas (ICP) en tierras indígenas en América Central." Universidad Nacional Autónoma de Costa Rica, Heredia, Costa Rica. May 8.
25. Herlihy, Peter H., and Dario Cruz Zelaya. 2015. "Proyecto Centroamérica Indígena: Los resultados de la Investigación Cartográfica Participativa en el Concejo Territorial Katainasta, Gracias a Dios, Honduras." Colloquium in Geography, University of Costa Rica, San José, Costa Rica. March 25.
26. Herlihy, Peter H., and Taylor A. Tappan. 2014. "PRM experience in the Honduran Moskitia." Geography Department at Universidad Nacional Autónoma de Costa Rica (UNA), Heredia, Costa Rica. Dec. 4.
27. Herlihy, P., T. Tappan, M. Fahrenbruch, J. Kelly, and J. Dobson. 2014. Formalizing Indigenous Land Tenure in La Moskita, Honduras: The value of participatory research mapping in identifying and mitigating conflict. 2014 joint meeting of the Great Plains/Rocky Mountain and Southwest Divisions of the Association of American Geographers; Albuquerque, NM. Oct. 24.
28. Tappan, T. A., Herlihy, P. H., J. H. Kelly, A. M. Hilburn, and J. E. Dobson. 2014. "Concejos Territoriales: New functional Indigenous territorial jurisdictions of the Honduran Moskitia." Conference of Latin Americanist Geographers, Panama City, Panama. Jan. 7.

- Honors and Awards:**
1. 2018-19. Tappan, T. A. US Fulbright-Hays DDRA Award to support dissertation research on land use/land cover change in Costa Rica.
 2. 2018. Herlihy, P. H. and Tappan, T. A. KU General Research Fund Competition for producing and publishing digital atlas of eastern Honduras's indigenous Mosquitia Region through University of Kansas Libraries.
 3. 2018. Tappan, T. A. KU Charles Stansifer Fellowship for dissertation research on land use/land cover change in Costa Rica.
 4. 2018. Tappan, T. A. Conference of Latin Americanist Geographers (CLAG) Field Study Award for dissertation research in Talamanca region of Costa Rica.
 5. 2018. Tappan, T. A. KU Graduate Student and Post-Doctoral Writing Incentive Fund for dissertation research in Costa Rica.
 6. 2017-18. Tappan, Taylor A. Federal Work Study Grant to work as Graduate Research Assistant on the University of Kansas Central America Indígena Project.
 7. 2017. Fahrenbruch, Matthew L., Fulbright IIE grant to support dissertation research on jellyfish and the Chinese fishery niche markets in Nicaragua.
 8. 2017. Fahrenbruch, Matthew L., University of Kansas Stansifer Award for Central American Research.
 9. 2017. Tappan, Taylor A., University of Kansas Robert Oppenheimer Memorial Scholarship for pre-dissertation field work on indigenous territoriality and land use/land cover change in Costa Rica.
 10. 2017. Tappan, Taylor A., University of Kansas International Programs Travel Grant for pre-dissertation field work on indigenous territoriality and land use/land cover change in Costa Rica.
 11. 2017. Tappan, Taylor A., University of Kansas Pierre A. Stouse Award for pre-dissertation field work on indigenous territoriality and land use/land cover change in Costa Rica.
 12. 2016. Herlihy, Peter H., First "Bowman Scholar" of the American Geographical Society. Awarded by the AGS Council on 18th November.
 13. 2016-17. Tappan, Taylor A., Federal Work Study Grant to work as Graduate Research Assistant on the University of Kansas Central America Indígena Project.
 14. 2016-17. Fahrenbruch, Matthew L., Federal Work Study Grant to work as Graduate Research Assistant on the University of Kansas Central America Indígena Project.
 15. 2015. CA Indígena Project wins the University of Kansas Sustainability Leadership Award.

Protocol Activity Status:

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Technology Transfer: 1. Online Website Publishing Research Results

Central America Indígena Research Team. 2015-present. "CA Indígena: Land Rights and Stability in Indigenous Societies of Central America."

Site: <http://www.prmapping.res.ku.edu/>

Website of research results. (Sponsored by the University of Kansas and American Geographical Society, with funding from US DoD Minerva Initiative for University-led Research).

A pioneering portal to original large-scale maps and geographic information needed for the governance and conservation of indigenous lands in Central America.

Downloadable products:

1. Large-scale settlement and land use maps from research in .pdf format

For examples, see http://prmapping.res.ku.edu/MASTA_CTs_ICP.html

2. Transparent static maps of settlement and land uses on satellite imagery in ArcGIS Online platform. For examples, see http://prmapping.res.ku.edu/ICP_1990s.html

3. Methodological content (in print, PowerPoint, and video) on the participatory research mapping (PRM)–geographic information systems (GIS) approach used. For examples, see <http://prmapping.res.ku.edu/english/PRM.html>

Each year, thousands of users from countries around the world (see MapLoco on website) have consulted and downloaded our cartographic results.

2. Offline "County" Database on Resilience, Stability, and Governance

Central America Indígena Research Team. 2015-present.

"CA Indígena: Database of Variables related to Land Rights and Stability in Indigenous Societies of Central America."

We have developed an ArcGIS Database related to the stability, resilience, and governances of the 1216 municipios (counties) in Central America. We first constructed an accurate map/shapefile of the municipal polygons and we have populated them with about over 50 different variables.

PARTICIPANTS:

Participant Type: PD/PI

Participant: Jerome Eric Dobson

Person Months Worked: 11.00

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Funding Support:

Participant Type: Co PD/PI

Participant: Peter Harry Herlihy

Person Months Worked: 15.00

Project Contribution:

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International Travel:

National Academy Member: N

Other Collaborators:

Funding Support:

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Publication Identifier Type: **Publication Identifier:** HLAS
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Authors: P. H. Herlihy
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CONFERENCE PAPERS:

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Conference Name: Association of American Geographers Annual Meeting
Date Received: **Conference Date:** 30-Apr-2016 **Date Published:** 30-Apr-2016
Conference Location: San Francisco, California
Paper Title: Developing Baseline Geographic Information through Participatory Research Mapping in Alto Chirripó Indigenous Reserve, Costa Rica
Authors: Taylor Tappan, Peter Herlihy, Aida Ramos, Matthew Fahrenbruch, Jerome Dobson
Acknowledged Federal Support: Y

DISSERTATIONS:

Publication Type: Thesis or Dissertation
Institution: University of Kansas
Date Received: 31-Aug-2016 **Completion Date:** 12/14/15 7:57PM
Title: A Cultural Historical Geography of Schools in the Honduran Mosquitia
Authors: Taylor Tappan
Acknowledged Federal Support: Y

WEBSITES:

URL: <http://www.ceiba.org.mx/que-hacemos/centro-de-documentacion/>
Date Received: 31-Aug-2016
Title: Centro Interdisciplinario de Biodiversidad y Ambiente, Mexico
Description: Forest Conservation Policies and the Neoliberal Land reform in Mexico: A Cultural Ecology Approach to the Payments for Environmental Services in The Huasteca Potosina Region
URL: <http://www.prmapping.res.ku.edu/>
Date Received: 13-Nov-2018
Title: CA Indigena Website
Description: This website was set up to display all data and activities of the Menerva funded CA Indigena Project.

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FINAL REPORT
October 29, 2018
PROPOSAL 64437-LS-MRI
AGREEMENT NUMBER: W911Nf-13-1-0281
J. E. Dobson PI, P. H. Herlihy Co-PI

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3. DATES COVERED: June 2013 to October 2018
4. TITLE: The Human Geography of Resilience and Change: Land Rights and Political Stability in Latin American Indigenous Societies
5. ALL CONTRACT NUMBERS
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 - b. Grant Number: W911NF1310281
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 - d. Task Number
 - e. Work Unit Number
6. AUTHOR(S): Dobson, Jerome E.; Herlihy, Peter H.
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES): University of Kansas, Youngberg Hall, Lawrence, KS 66047.
8. PERFORMING ORGANIZATION REPORT NUMBER:
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES): Office of the U. S. Secretary of Defense
10. SPONSOR/MONITOR'S ACRONYM(S): ARO
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12. DISTRIBUTION/AVAILABILITY STATEMENT: Unrestricted

13. SUPPLEMENTARY NOTES:

14. ABSTRACT: Since 2013 KU Professors Jerry Dobson and Peter Herlihy and a small group of graduate students from the University of Kansas have led *Centroamérica Indígena*, a massive effort including collaborations with indigenous and state governments, and NGOs, to understand indigenous societies in Central America. Funded by a prestigious Minerva Grant for University-led Research from the Office of the Secretary of Defense and Army Research Office, they study the geographic factors that favor stability, instability, and resilience in indigenous municipalities throughout the seven countries of Central America. Most communities suffer similar stresses—social and political discrimination, land dispossession, extreme poverty, narco-trafficking, and violence. Yet, some communities are thriving, protecting lands, managing natural resources, and maintaining cultural identities while others are not. The project focuses on secure land ownership and territorial sovereignty as key variables to be tested.

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Their success story should be of interest to anyone in the intelligence, foreign policy, and military strategy communities. Participatory research mapping (PRM) maps land *cheaper* than ever before at *finer resolutions* and with *pre-validation* and *pre-approval* by the resident population, plus [this innovative methodology](#) educates and creates goodwill and lasting relationships that can serve whenever crises arise in the future. These benefits result from a cooperative exercise of inter-governmental and non-governmental organizations and broader use of PRM within the context of a unified regional GIS to address social and scientific research questions.

15. SUBJECT TERMS: Participatory Research Mapping, Land Rights, Land Use, Resilience

16. SECURITY CLASSIFICATION: Unclassified

17. LIMITATION OF ABSTRACT: None

1) **Submissions or Publications**

a) **Papers published in peer-reviewed journals (12):**

1. Herlihy, P. H., M. Fahrenbruch, T. A. Tappan. 2019. Recognizing Indigenous Territorial Jurisdictions in Forest Conservation in Central America," *Tropical Conservation Science*, submission.
2. Herlihy, P.H. and T.A. Tappan. 2019. "Recognizing Indigenous Territorial Jurisdiction in Central America," in *Territorializing Space in Latin America: Processes and Perceptions*. Edited by Michael McCall and Brian Napoletano. Springer Press, forthcoming.
3. Fahrenbruch, M.L. 2018. "'Like scooping money out of the sea': Chinese luxury seafood consumption, roving bandits, and the boom-and-bust jellyfish fishery on the Miskitu Coast of Nicaragua. *Journal of Latin American Geography* 17(2): 209-238.
4. Fahrenbruch, M.L. 2018. Pesquerías de Medusa en la Costa Miskitu: Desafíos para la Gobernanza Comunal Después de la Ley 445 de Nicaragua. *Revista Geográfica de América Central*. Special Edition, Heredia, Costa Rica.
5. Cochran, D. M. and P. H. Herlihy. 2018. "Central America," In *Handbook of Latin American Studies*, No. 73. Social Sciences. Edited by Katherine McCann & Tracy North. Austin, University of Texas Press.
6. Tappan, T. A. and P. H. Herlihy. 2018. "Mapping Miskitu Subsistence Land Use Change in Concejo Territorial KATAINASTA, Honduras," *Revista Geográfica de América Central*. Special Edition, Heredia, Costa Rica.
7. Herlihy, P. H., and T. A. Tappan. 2018 "Recognizing Indigenous Miskitu Territory in Honduras." *Geographical Review*. June. Pp. 1-28. DOI: <https://doi.org/10.1111/gere.12309>. See <https://rdcu.be/1061>
8. Kelly, John H., Peter H. Herlihy, Taylor A. Tappan, Andrew Hilburn, and Matthew Fahrenbruch. 2017. "From Cognitive Maps to Transparent Static Web Maps: Tools for Indigenous Territorial Control in La Muskitia, Honduras." *Cartographica* (Toronto, Ontario, Canada: University of Toronto Press) 52, Spring (Spring): 1-19. doi:10.3138/cart.52.1.3811.
9. Fahrenbruch, M.L. 2017. "Cucharear dinero del mar": La producción de medusas en La Mosquitia. *Wani Revista del Caribe Nicaragüense*, 72:31-38.
10. Herlihy, P. H., & Cochran, D. M. 2016. "Central America." In *Handbook of Latin American Studies*, No. 71. Social Sciences. Pp. 33-45. Edited by Katherine McCann and Tracy North. Austin, University of Texas Press.
11. Aguilar, Fredis Mateo, Peter H. Herlihy, Taylor A. Tappan, and José Darío Cruz. 2014. "Proyecto Centroamérica Indígena." *La Tribuna* (Tegucigalpa, Honduras) 27 Oct.
12. Herlihy, Peter H. 2014. "Central America." *Handbook of Latin American Studies*, No. 69, Social Sciences. Pp. 29-41. Edited by Tracy North. Austin, University of Texas Press.

b) Map publications (17)

1. Central América Indígena Research Team, et al. 2018. "**DEPARTAMENTO DE SACATEPEQUEZ. Cobertura de Suelo, Rasgos culturales, Límites Fronterizos.**" Los resultados cartográficos fueron realizados a través de una Investigación Cartográfica Participativa (ICP) y la Capacitación y Certificación de Geógrafos Locales en el Concejo Territorial. Mapa digital publicado en color, escala 1:50,000. Guatemala City, Universidad de San Carlos (USAC), Guatemala.
2. Central América Indígena Research Team, et al. 2018. "**RESERVA INDIGENA ALTO CHIRRIPO. Uso de Tierra, rasgos topográficos, límites administrativos, y rasgos culturales.**" Los resultados cartográficos fueron realizados a través de una Investigación Cartográfica Participativa (ICP) y la Capacitación y Certificación de Geógrafos Locales en el Territorio Indígena Alto Chirripó. Costa Rica, 2015-2018. Mapa digital publicado en color, escala 1:50,000. Heredia, Universidad Nacional Autónoma de Costa Rica (UNA).
3. CA Indígena Research Team. 2017. **WAMAKKLISINASTA**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO).
http://prmapping.res.ku.edu/CT_Maps/Wamakklisinasta.pdf
4. CA Indígena Research Team. 2017. **AUHYA YARI**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO).
http://prmapping.res.ku.edu/CT_Maps/Auhya_Yari.pdf
5. CA Indígena Research Team. 2017. **TAWAHKA**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO).
http://prmapping.res.ku.edu/CT_Maps/AreaTawaka.pdf
6. CA Indígena Research Team. 2017. **BAKINASTA**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land

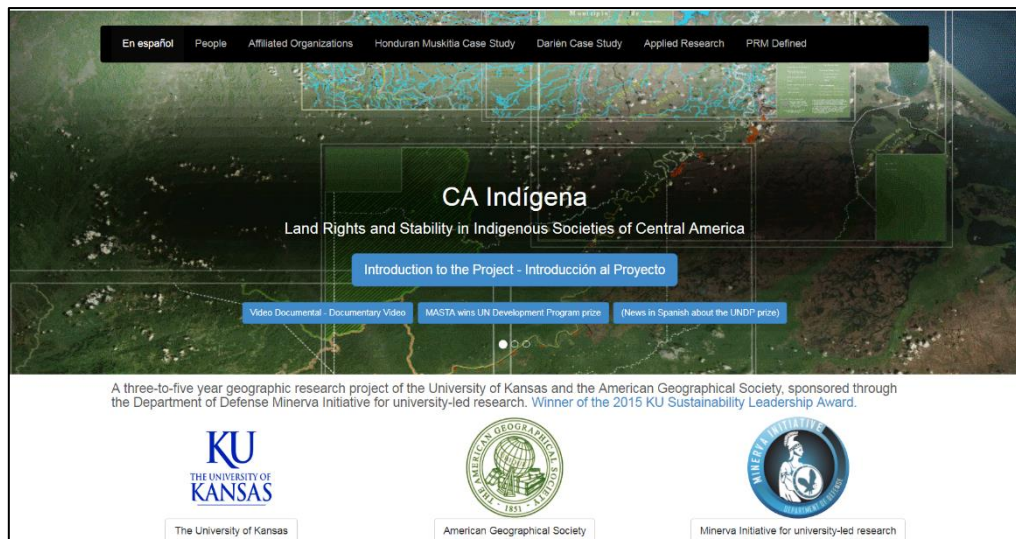
- Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO). Web.
http://prmapping.res.ku.edu/CT_Maps/Bakinasta.pdf
7. CA Indígena Research Team. 2017. **BAMIASTA**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO).http://prmapping.res.ku.edu/CT_Maps/Bamiasta.pdf
 8. CA Indígena Research Team. 2017. **BATIASTA**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO). http://prmapping.res.ku.edu/CT_Maps/Batiasta.pdf
 9. CA Indígena Research Team. 2017. **DIUNAT**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO). http://prmapping.res.ku.edu/CT_Maps/Diunat.pdf
 10. CA Indígena Research Team. 2016. **KATAINASTA**. 1:50,000 scale. Maps produced with and distributed to, the following collaborators: MASTA (Miskitu indigenous federation); FITH (Tawahka Indigenous Federation); Miskitu and Tawahka communities of each territorial council; Universidad Pedagógica Nacional Francisco Morazán (Tegucigalpa, Honduras); Honduran Land Management Program (PATH II); GIZ International Development Program; Honduran Forestry Conservation (ICF); United Nations Development Program (UNDP); MOPAWI (Miskitu development NGO). Web.
http://prmapping.res.ku.edu/CT_Maps/Katainasta.pdf
 [Large-format printed version of this map was included in the 28th International Cartographic Exhibition, Washington, DC, July 2-7, 2017]
 11. Herlihy, Peter H., Andrew M. Hilburn, John H. Kelly, and Jerome E. Dobson. 2013. "Asentamientos y Carreteras de la Reserva de Biosfera Tawahka-Asangni." http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_asentamientos.pdf
 12. Hilburn, Andrew M., Peter H. Herlihy, John H. Kelly, and Jerome E. Dobson. "Rasgos Climatalógicos de la Reserva de Biosfera Tawahka-Asangni". 2013. http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_clima.pdf
 13. Herlihy, Peter H., Andrew M. Hilburn, John H. Kelly, and Jerome E. Dobson.

- "Las Divisiones Administrativas de la Reserva de Biósfera Tawahka-Asangni". 2013. http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_admin.pdf Digital map at 1:125,000 scale for use by FITH (Federación Indígena Tawahka Hondurena).
14. Hilburn, Andrew M., Peter H. Herlihy, John H. Kelly, and Jerome E. Dobson. "Los Ecosistemas de la Reserva de Biósfera Tawahka-Asangni". 2013. http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_clima.pdf Digital map at 1:125,000 scale for use by FITH (Federación Indígena Tawahka Hondurena).
15. Hilburn, Andrew M., Peter H. Herlihy, John H. Kelly, and Jerome E. Dobson. "Pendientes de la Reserva de Biosfera Tawahka-Asangni". 2013. http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_pendientes.pdf
16. Hilburn, Andrew M., Peter H. Herlihy, John H. Kelly, and Jerome E. Dobson. "Relieve de la Reserva de Biosfera Tawahka-Asangni". 2013. http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_relieve.pdf
17. Hilburn, Andrew M., Peter H. Herlihy, John H. Kelly, and Jerome E. Dobson. "Zonificación la Reserva de Biosfera Tawahka-Asangni". 2013. http://www.prmapping.res.ku.edu/Tawahka_plan_de_manejo_zonificacion.pdf

c) Website Publishing and Databases in ArcGIS.

1. Website Publishing (1)

Central America Indígena Research Team. 2015-present. *CA Indígena: Land Rights and Stability in Indigenous Societies of Central America*. Website. Lawrence, University of Kansas. Website <http://www.prmapping.res.ku.edu/>



The CA Indígena website was first opened in March 2015 and it has about 3,500 views over the last 2.5 year period (*maploco* data).

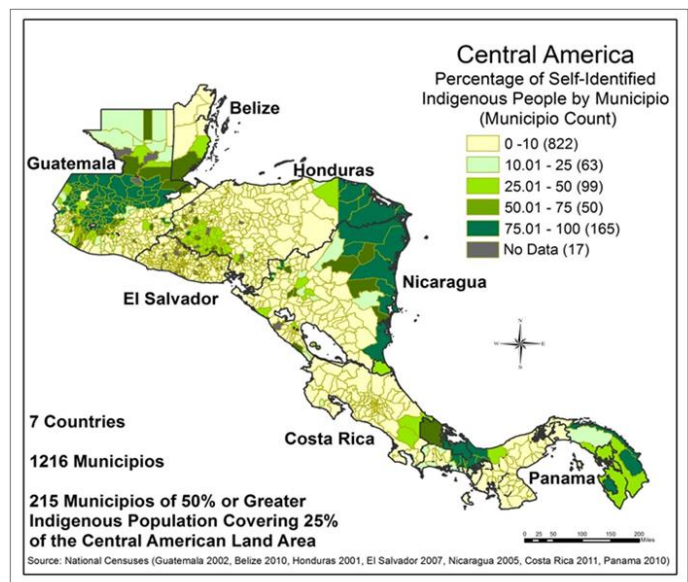
The CA Indígena Website has indigenous, state, NGO, and university users from all around the world who:

- a) consult our detailed, specific cartographic results,
- b) download our published large-scale maps of different indigenous parts of the Central America where the CA Indígena project worked,
- c) use our novel “transparent static maps” on satellite imagery in ArcGIS Online, which include long-term land use and place name locations that have helped form the basis for successful territorial claims by indigenous stakeholders; and
- d) view our project videos, reports, and more.

2. Databases in ArcGIS (2)

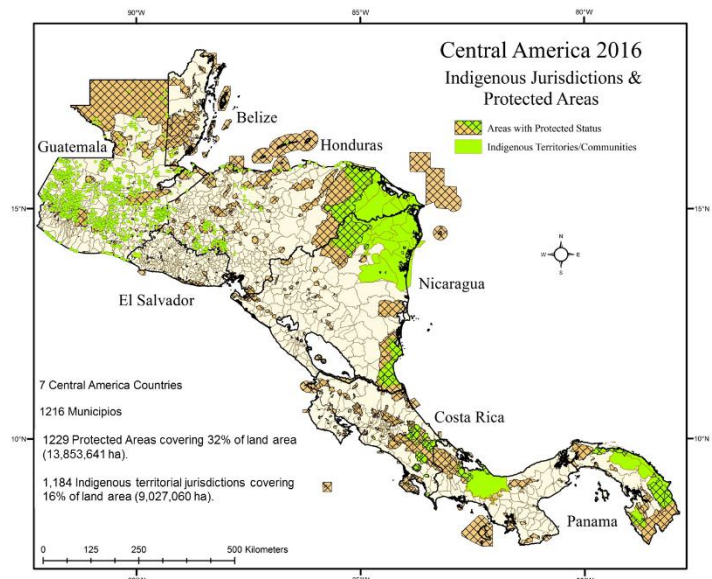
1) CENTRAL AMERICA REGIONAL MUNICIPAL DATABASE

The *municipio* (a county-level administrative unit) is one of our basic units of scale and analysis, of which our GIS has integrated the approximately 1216 municipios in Central America into one spatial coverage, into which we are populating mainly census variables related to the stability of indigenous lands in the region.



2) CENTRAL AMERICA INDIGENOUS TERRITORIAL JURISDICTIONS (ITJs) DATABASE

We also work on the ground with indigenous communities, government agencies, NGOs, and universities in Honduras, Guatemala, and Costa Rica to map indigenous territorial jurisdictions at 1:50,000 scale or larger. These



case studies give us a grassroots perspective to understand the indigenous territorial jurisdictions across Central America. They add depth to our Central American GIS which will display all indigenous territorial jurisdictions in the region.

a) Presentations

i) Presentations at meetings, but not published in Conference Proceedings (29):

1. Fahrenbruch, M.L. 2018. "Getting that Jellyfish Crunch": Sequential Exploitation, Cannonball Jellyfish, and the Global Jellyfish Market. Great Plains/Rocky Mountain AAG, Manhattan, Kansas. October 5-6, 2018.
2. Herlihy, P.H., M.L.Fahrenbruch, and T.A. Tappan. 2018. "Indigenous Territorial Jurisdictions and Forest Conservation in Central America." Great Plains/Rocky Mountain AAG, Manhattan, Kansas. October 5-6, 2018.
3. Fahrenbruch, M.L. 2018. Challenges to Demarginalization. The case of fisheries governance and the development of the export jellyfish fishery on the Miskito Coast of Nicaragua (Paper). International Geographical Union (IGU) in Quebec City, Canada. August 6-10, 2018.
4. Fahrenbruch, M.L. 2018. "Nobody ever came": Communal Governance and Jellyfish Fisheries in Post-Law 445, Nicaragua. . Paper Presented at the 35th Conference of Latin Americanist Geographers in San Jose Costa Rica. May 20-22, 2018.
5. Herlihy, P. H. 2018. "Recognizing Indigenous Territories in Central America," Paper presented at the 35th Conference of Americanist Geographers, San José, Costa Rica. May 22.
6. Tappan, T. A. 2018. "Constructing Latin and Legitimizing Indigenous Miskitu Territory through 25 Years of Land and Resource Use Mapping." Conference of Latin Americanist Geographers. May 21-22, San José, Costa Rica.
7. Herlihy, Peter H., and Taylor A. Tappan. 2017. "Participatory Research Mapping in Alto Chirripó Indigenous Reserve." Invited presentation at the Instituto Geográfico Nacional, San José, Costa Rica. August 16.
8. Herlihy, Peter H., and Taylor A. Tappan. 2017. "Preliminary Results of Participatory Research Mapping Pilot Study in Costa Rican Talamanca." Invited presentation at School of Geography, University of Costa Rica, March 20th, San José, Costa Rica. March 20.
9. Herlihy, Peter H. and Taylor A. Tappan. 2017. "Preliminary Results of Participatory Research Mapping Pilot Study in Costa Rican Talamanca." Invited presentation at School of Geography, University of Costa Rica, San José, Costa Rica. 20 March.
10. Tappan, Taylor A. 2017. "Mapping Land Cover Change in Alto Chirripó, Costa Rica." Brownbag series presentation at Department of Geography and Atmospheric Science, University of Kansas, Lawrence, KS. 18 April.
11. Herlihy, Peter H. and Taylor A. Tappan. 2017. "Participatory Research Mapping in Alto Chirripó Indigenous Reserve." Invited presentation at Instituto Geográfico Nacional, San José, Costa Rica. 16 August.

12. Herlihy, P. H. 2016. "Indigenous Peoples and Forest Conservation in Central America." *Geography 2050: Envisioning a Sustainable Planet*, Columbia University, New York. 18 November. See <http://www.geography2050.info/>
13. Dobson, J. E. August 22, 2016, "Community-Based Mapping for Governance and Stability in Central America," U. S. Department of State, invited lecture sponsored by Bureau of Intelligence and Research (INR).
14. Tappan, T. A. 2016. "Desarrollando Información Geográfica de Base a través de las Investigaciones Cartográficas Participativas (ICP) en la Muskitia Hondureña." Food and Agricultural Organization (FAO) Mesoamerican Conference on Open Tenure. May 16-20. Sololá, Guatemala.
15. Tappan, T. A., P. H. Herlihy, A. R. Viera, M. L. Fahrenbruch, and J. E. Dobson. 2016. "Developing Baseline Geographic Information through Participatory Research Mapping in Alto Chirripó Indigenous Reserve, Costa Rica." Association of American Geographers conference. March 29-April 1. San Francisco, CA.
16. Ramos, A., P.H. Herlihy, T.A. Tappan, and J.E. Dobson. 2016. "Participatory Research Mapping (PRM) in Sacatepéquez, Guatemala. Municipios and Tierras Comunales." Conference of the Association of American Geographers, San Francisco, CA. March 29.
17. Dobson, Jerome E., Peter H. Herlihy, Taylor A. Tappan (presenter), Matthew L. Fahrenbruch, and Aida Ramos Viera. 2015. "Land Rights and Stability in Indigenous Societies of Central America." Minerva Meeting and Program Review Conference, Washington, D.C. September 9-10.
18. Tappan, Taylor A., Peter H. Herlihy, Aida Ramos Viera, Mathew L. Fahrenbruch, and Jerome E. Dobson. 2016. "Developing Baseline Geographic Information through Participatory Research Mapping in Alto Chirripó Indigenous Reserve, Costa Rica." Association of American Geographers annual conference, San Francisco, California. March 29.
19. Fahrenbruch, M.L., P.H. Herlihy, T.A. Tappan, A. Ramos, J.H. Kelly, and J.E. Dobson. 2016. Participatory Research Mapping in the Concejos Territoriales of the Honduran Muskitia: Observations on Changing Resource Use Patterns. Conference of the Association of American Geographers, San Francisco, CA. March 29.
20. Herlihy, Peter H., Edgardo Benítez Maclin, and Taylor A. Tappan. 2015. "Biosphere Reserves are Not Enough: Protecting Indigenous Tawahka Lands and Peoples in the Honduran Muskitia." International Conference of Latin Americanist Geographers (CLAG), Fortaleza, Brazil. May 27.
21. Herlihy, Peter H., Taylor A. Tappan (presenter), Matthew L. Fahrenbruch, John H. Kelly, and Jerome E. Dobson. 2015. "Establishing a New Indigenous Territory for the Miskitu in Honduras." Conference of Latin Americanist Geographers. Fortaleza, Brazil. May 26-30.
22. Herlihy, Peter H., Taylor A. Tappan, and Donald Allen. 2015. "La Investigación Cartográfica Participativa (ICP) en América Central y Honduras." Instituto Geográfico Nacional (IGN), with municipal leaders from the Department of Sacatepéquez, Antigua, Guatemala. May 11.
23. Herlihy, Peter H., Taylor A. Tappan, and Donald Allen. 2015. "La Investigación Cartográfica Participativa (ICP) de las tierras indígenas de La Muskitia,

- Honduras." Alto Chirripó Indigenous Cabécar Territory Commission, Grano de Oro, Talamanca, Costa Rica. May 9.
24. Herlihy, Peter H., Taylor A. Tappan, and Donaldo Allen. 2015. "Las investigaciones cartográficas participativas (ICP) en tierras indígenas en América Central." Universidad Nacional Autónoma de Costa Rica, Heredia, Costa Rica. May 8.
 25. Herlihy, Peter H., and Dario Cruz Zelaya. 2015. "Proyecto Centroamérica Indígena: Los resultados de la Investigación Cartográfica Participativa en el Concejo Territorial Katinasta, Gracias a Dios, Honduras." Colloquium in Geography, University of Costa Rica, San José, Costa Rica. March 25.
 26. Herlihy, Peter H., and Taylor A. Tappan. 2014. "PRM experience in the Honduran Moskitia." Geography Department at Universidad Nacional Autónoma de Costa Rica (UNA), Heredia, Costa Rica. Dec. 4.
 27. Herlihy, P., T. Tappan, M. Fahrenbruch, J. Kelly, and J. Dobson. 2014. Formalizing Indigenous Land Tenure in La Moskita, Honduras: The value of participatory research mapping in identifying and mitigating conflict. 2014 joint meeting of the Great Plains/Rocky Mountain and Southwest Divisions of the Association of American Geographers; Albuquerque, NM. Oct. 24.
 28. Tappan, T. A., Herlihy, P. H., J. H. Kelly, A. M. Hilburn, and J. E. Dobson. 2014. "Concejos Territoriales: New functional Indigenous territorial jurisdictions of the Honduran Moskitia." Conference of Latin Americanist Geographers, Panama City, Panama. Jan. 7.
 29. Dobson, J. E. 2018. "The American Geographical Society in Latin America." Conference of Latin Americanist Geographers, San Jose, Costa Rica. May 21.

b) Manuscripts (4)

1. Herlihy, Peter H. Taylor A. Tappan, John H. Kelly, Matthew L. Fahrenbruch, Jerome E. Dobson. 2018. Manuscript under revision. "Participatory Research Mapping of the indigenous Miskitu Concejo Territorial of KATAINASTA. Manuscript for *The Journal of Cartography*.
2. Tappan, T. A.; P. H. Herlihy, and S. L. Egbert. "Mapping Land Use/Land Cover Change in Alto Chirripó Indigenous Reserve, Costa Rica." Completed manuscript. Expected submission in *Journal of Central American Geography* (Costa Rica, peer-reviewed).
3. Herlihy, P., Hilburn, A., Kelly, J., Ramos Viera, A., Smith, D., Aguilar Robledo, M., & Dobson, J. 2020. "Indigenous Territoriality and the Núcleo Agrario in Mexico" in *Invisible Borders in a Very Bordered World: Subversive Political Geographies in the Twenty-first Century*. Edited by Alexander Diener and Joshua Hagen.
4. Dobson, J. E. 2019. "The American Geographical Society's Bowman Expeditions, 2005-2018." Partial Manuscript. Expected submission to *Transactions of the Institute of British Geographers* (peer-reviewed).

c) Books

d) Honor and Awards (15)

1. 2018-19. Tappan, T. A. US Fulbright-Hays DDRA Award to support dissertation research on land use/land cover change in Costa Rica.
2. 2018. Herlihy, P. H. and Tappan, T. A. KU General Research Fund Competition for producing and publishing digital atlas of eastern Honduras's indigenous Mosquitia Region through University of Kansas Libraries.
3. 2018. Tappan, T. A. KU Charles Stansifer Fellowship for dissertation research on land use/land cover change in Costa Rica.
4. 2018. Tappan, T. A. Conference of Latin Americanist Geographers (CLAG) Field Study Award for dissertation research in Talamanca region of Costa Rica.
5. 2018. Tappan, T. A. KU Graduate Student and Post-Doctoral Writing Incentive Fund for dissertation research in Costa Rica.
6. 2017-18. Tappan, Taylor A. Federal Work Study Grant to work as Graduate Research Assistant on the University of Kansas Central America Indígena Project.
7. 2017. Fahrenbruch, Matthew L., Fulbright IIE grant to support dissertation research on jellyfish and the Chinese fishery niche markets in Nicaragua.
8. 2017. Fahrenbruch, Matthew L., University of Kansas Stansifer Award for Central American Research.
9. 2017. Tappan, Taylor A., University of Kansas Robert Oppenheimer Memorial Scholarship for pre-dissertation field work on indigenous territoriality and land use/land cover change in Costa Rica.
10. 2017. Tappan, Taylor A., University of Kansas International Programs Travel Grant for pre-dissertation field work on indigenous territoriality and land use/land cover change in Costa Rica.
11. 2017. Tappan, Taylor A., University of Kansas Pierre A. Stouse Award for pre-dissertation field work on indigenous territoriality and land use/land cover change in Costa Rica.
12. 2016. Herlihy, Peter H., First "Bowman Scholar" of the American Geographical Society. Awarded by the AGS Council on 18th November.
13. 2016-17. Tappan, Taylor A., Federal Work Study Grant to work as Graduate Research Assistant on the University of Kansas Central America Indígena Project.
14. 2016-17. Fahrenbruch, Matthew L., Federal Work Study Grant to work as Graduate Research Assistant on the University of Kansas Central America Indígena Project.
15. 2015. *CA Indígena* Project wins the University of Kansas Sustainability Leadership Award.

e) Title of Patents Disclosed during the reporting period

f) Patents Awarded during the reporting period

2) Student/Supported Personnel Metrics for this Reporting Period (name, % supported, %Full Time Equivalent (FTE) support provided by this agreement, and total for each category):

a) Number of Undergraduate STEM Students: 0

b) Number of Graduate STEM Students: 2

1. Matthew Fahrenbruch, Ph.D. candidate: 50% GRA appointment
2. Taylor Tappan, Ph.D. student: 50% GRA appointment

c) Number of Students that received a STEM degree: 0

d) Other Research staff:

- Aida Ramos Viera, Ph.D., post-doctoral researcher
- John H. Kelly, Ph.D., post-doctoral researcher
- Andrew M. Hilburn, Ph.D., post-doctoral researcher

3) “Technology Transfer”

1. Online Website Publishing Research Results

Central America Indígena Research Team. 2015–present. “*CA Indígena: Land Rights and Stability in Indigenous Societies of Central America.*”

Site: <http://www.prmapping.res.ku.edu/>

Website of research results. (Sponsored by the University of Kansas and American Geographical Society, with funding from US DoD Minerva Initiative for University-led Research).

A pioneering portal to original large-scale maps and geographic information needed for the governance and conservation of indigenous lands in Central America.

Downloadable products:

1. Large-scale settlement and land use maps from research in .pdf format
For examples, see http://prmapping.res.ku.edu/MASTA_CTs_ICP.html
2. Transparent static maps of settlement and land uses on satellite imagery in ArcGIS Online platform. For examples, see http://prmapping.res.ku.edu/ICP_1990s.html
3. Methodological content (in print, PowerPoint, and video) on the participatory research mapping (PRM)–geographic information systems (GIS) approach used. For examples, see <http://prmapping.res.ku.edu/english/PRM.html>

Each year, thousands of users from countries around the world (see *MapLoco* on website) have consulted and downloaded our cartographic results.

2. Offline “County” Database on Resilience, Stability, and Governance

Central America Indígena Research Team. 2015–present.

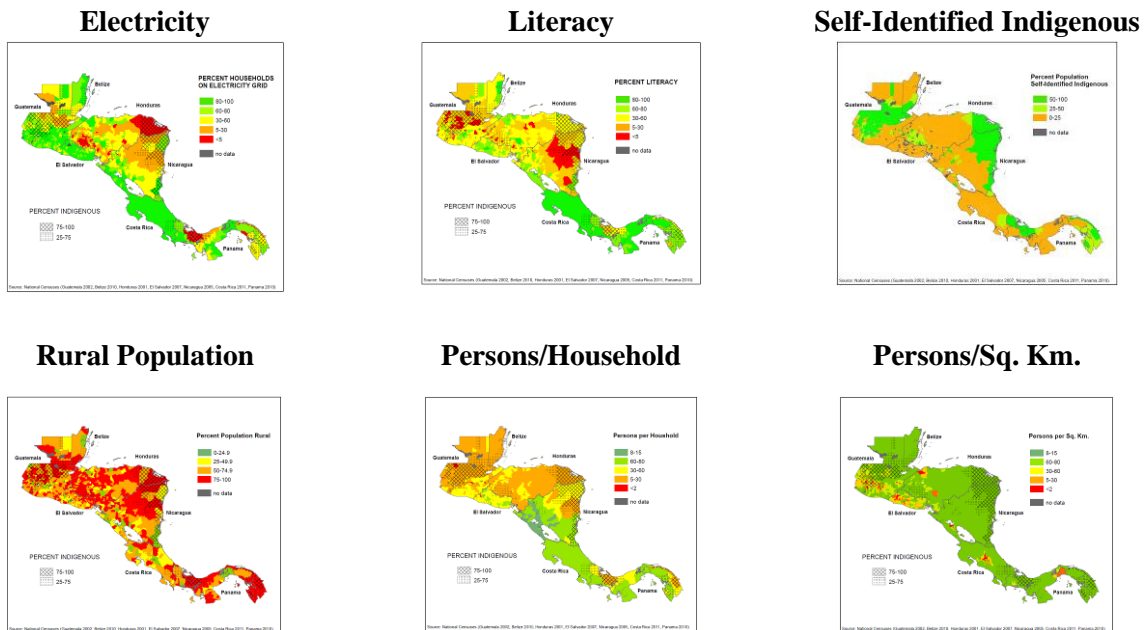
“*CA Indígena: Database of Variables related to Land Rights and Stability in Indigenous Societies of Central America.*”

We have developed an ArcGIS Database related to the stability, resilience, and

governances of the 1216 municipios (counties) in Central America. We first constructed an accurate map/shapefile of the municipal polygons and we have populated them with about over **50 different variables**.

1. Total Population
2. Self-Identified Indigenous Population
3. Literacy
4. Number of Households
5. Persons per Home
6. Electricity in Home
7. Area in sq. km. of Municipios
8. % Population Rural
9. % Population Urban
10. Persons per sq. km.
11. Homes per sq. km.
12. Forest Cover (MEAN for 2010): Based on
(<http://landcover.usgs.gov/glc/TreeCoverDescriptionAndDownloads.php>)
13. Forest Loss (2000-2017): <http://earthenginepartners.appspot.com/science-2013-global-forests>
14. Number of houses
15. Water Supply variables
 - PIPE_IN_DW: Number of houses with running water inside the house
 - PIPE_IN_PR: Number of houses with running water at their property but not inside the house
 - TUB_OUT: Number of houses with running water outside the property
 - WITHOUT_TU: Number of houses without running water
 - PER_W_PIPE: Percentage of houses with running water
 - PER_NO_PIPE: Percentage of houses without running water
 - WELL: Number of houses well fed
 - PER_WELL: Percentage of houses well feed
 - RIV_LAKE_S: Number of houses where the main water supply is by river, lake or spring
 - PER_LAKE_S: Percentage of houses where the main water supply is by river, lake or spring
 - TRUCK: Number of houses where trucks provide water to residents
 - PER_TRUCK: Percentage of houses where trucks provide water to residents
 - TANK: Number of houses where tanks are the main source of water supply
 - PER_TANK: Number of houses where tanks are the main source of water supply
 - OTHER_HOUSE: Number of houses that obtain their water supply from another house (neighbor)
 - RAIN: Number of houses where rain is the main source of water supply
 - PER_RAIN: Percentage of houses where rain is the main source of water supply
 - OTHER: Number of houses where the main source of water supply is different from the above
 - PER_OTHER: Percentage of houses where the main source of water supply is different from the above
16. Land Tenure variables
 - T_Propia: Number of houses that are owned by their residents, it includes with and without titles and houses under mortgage

- T_Rentada: Number of houses where their residents are renting
 - T_Cedida_o: Number of houses lent, ceded or other to their residents are renting
 - Total_vivi: Total number of houses censused for land tenure data
 - P_Owners: Percentage of houses in the municipio that are owned by their residents, it includes with and without titles and houses under mortgage
 - P_Renting: Number of houses where their residents are renting
 - P_Ceded_ot: Percentage of houses lent, ceded or other to their resident
17. Protected areas shapefiles (National parks, biosphere, nature reserves) for each CA country: Belize, El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica, and Panama.
 18. Indigenous Territorial Jurisdictions shapefiles (Comarcas, reservas, tierras autónomas, concejos territoriales) for each CA country: Belize, El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica, and Panama.
 19. Political Divisions Variables:
 - a. Federal, b. state, c. county, and d. municipal boundries shapefiles for all CA countries.
 20. Visualization of variable in ArcGIS allow display of 100s of maps.



3. Knowledge transfer

GIS technological and other geographic skills were transferred to the extent possible over the duration of the grants to 9 indigenous and non-indigenous college-level students and about 100 “local geographers” that we trained in Honduras, Costa Rica, and Guatemala, through the our multi-year participatory research mapping (PRM) and data collection activities described above.

We also an unrelated developed a one-week intensive training course by John Kelly and Taylor Tappan for secondary school instructors in Choluteca, Honduras.

4) Scientific Progress and Accomplishments

a) Working with indigenous communities and their governing federations, as well as state organizations and NGOs in Central America, we have produced the precise large-scale cartographic information needed for the governance of their conflictive lands that experience drug-trafficking, land-grabbing, and mega-development pressures.

We published large-scale digital maps of:

1. eight new *Concejos Territoriales* (multi-village community-titled territory) in La Mosquitia, Honduras;
2. the *Reserva Indígena Alto Chirripo* in the Talamanca highlands, Costa Rica; and
3. the *Department of Sacatepéquez* in the highlands of Guatemala, made using participatory research mapping (PRM) with geographic information systems (GIS).

See maps at http://prmapping.res.ku.edu/MASTA_CTs_ICP.html

b) We demonstrated the participatory research mapping-GIS (PRM-GIS) works well for producing and updating cartographic sheets abroad.

For example, in the Honduran Mosquitia, our results in print and digital formats cover the area of 25 official 1:50,000 topographic sheets that had not been updated since first publishing in the 1960s or 1970s (when the National Geographic Institute (IGN) worked with the US Defense Mapping Agency (DMA) to do this expensive work).

c) We completed another PRM-GIS pilot study in the 750km² indigenous Cabécar territory of the Costa Rican Talamanca highlands. The cartographic results will be used by the governing indigenous authorities in developing their territory's first management plan for resource use and land tenure. The results include detailed large-scale maps with thousands of previously undocumented toponyms (place names) and land use locations, all generated and carefully verified by community-chosen local investigators and other community members.

d) We have developed an ArcGIS Database of variables related to the stability, resilience, and governances of all seven states in Central America, using the 1216 *municipios* (counties) as the unit of analysis. We first constructed an accurate map of these municipal polygons, to form the base units to query and analyze. We have about 40 different variables that we have finished populating the data in each of the 1216 *municipios*.

e) Since the project began in 2013, working with indigenous, university, state, and NGO collaborators, we have completed difficult field research in complicated and conflictive indigenous regions of Honduras, Costa Rica, and Guatemala, publishing new cartographic information of great detail and precision, while also plotting the settlements, land uses, land cover, and other culturally significant features.



f) We presented our cartographic results together with our indigenous collaborators to the Honduran government in a meeting with the Director of the RAN and also to INEGI in Costa Rica. In Honduras we collaborated directly with the Honduran World Bank Project PATH II.

g) As time-consuming participatory research mapping (PRM) field-based research and GIS database development has been completed, we are now publishing on a variety of different parts of the enormous original database created by the project.

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