Indigenous Knowledge and the Search for Medicine: Controversy in Chiapas

by
Angela C. Oviedo,
Patrick R. Field, & Daniela J. Shebitz
Kean University, Union, NJ

Introduction

Bioprospecting at a Glance

When thinking of drug discovery, it is easy to picture research being conducted in giant sterile laboratories with shelves and tables filled with chemicals in vials and test tubes. However, before scientists conduct research in the labs with admirable precision, there are a unique group of people whose collective knowledge has allowed for the creation of what we now know as modern medicine. In what is referred to as a "developed country," it seems as though any ailment can be resolved with the right mix of chemicals. From headaches to nausea, and cancer to HIV/AIDS, we rely heavily on western pharmaceutical drugs to alleviate or cure the condition. When seeking relief in the United States, we have the privilege of being able to go to the nearest pharmacy to gain the right over-the-counter medication. However, throughout much of the world, plants provide natural medicine to people who have been taught by their elders about how to heal themselves and others without relying on synthetic medicines. This form of traditional medicine (TM) is receiving increasing attention worldwide because of the significant role that it plays in meeting the health needs of people in developing countries. Already, traditional medicine comprises a multi-billion-dollar industry and the biomedical sector is increasingly investigating the potential of new pharmaceuticals based on traditional knowledge (Abbott, 2014).

The connection between lab and natural sources of medicine is made through bioprospecting, all for the purpose of discovering new products that will benefit human health. In fact, as much as one-third to one-half of pharmaceutical drugs were originally derived from plants (Barrett, Kiefer, & Rabago, 1999). Pharmaceutical companies invest billions of dollars each year with the hope of developing safe and effective chemicals that can be manufactured cost effectively (Abbott, 2014). Yet, on average, one out of every 10,000 pure compounds that are biologically evaluated achieves regulatory approval (Vogel, 2010). To increase these odds, bioprospectors can take an ethnobotanical approach to drug discovery by observing practices of indigenous people who rely on plants as their main source of medicine. Traditional ecological knowledge (TEK) of indigenous people can provide guidance in selecting and gathering plants that may have important therapeutic uses. A long history of clinical use within an indigenous community suggests that an herbal medicine may be clinically effective, and bioactive compounds that can be derived from these plants may have minimal toxicity (Abbott, 2014).

Bioprospectors apply information gathered from an indigenous community's usage of biological resources and find ways for the rest of the world to have access to these resources. Simultaneously, they attempt to find new ways for the indigenous people to benefit from their findings while promoting the conservation of these resources. The process of building trust between the bioprospectors and the community takes time. Therefore, the scientists gathering information often may play an active role in the community and provide a form of compensation to the native participants for sharing their knowledge. Although the overall goal of bioprospecting groups may be a noble one, many face accusations of immoral practices that overshadow their work, as was the case with the Maya ICBG.

Angela Oviedo is an undergraduate student and Daniela Shebitz is an associate professor in the School of Environmental and Sustainability Science at Kean University. Patrick Field is an associate professor in the Department of Biology, School of Natural Sciences, also at Kean.

ICBG

The International Cooperative Biodiversity Group (ICBG) was a program established by the National Institutes of Health (NIH), the National Science Foundation (NSF) and the United States Agency for International Development (USAID) (Berlin & Berlin, 2004; Nigh, 2002; Rosenthal, 1997). The program was designed to encourage the exploration of foreign countries in order to protect biodiversity, to find new sources of medicine and to improve economic activity in the host country. All ICBGs were to be composed of an academic institution from the United States, a local and international voluntary organization and a pharmaceutical firm (Rosenthal, 1997).

The Maya ICBG

The Maya ICBG consisted of three institutions (Berlin *et al.,* 1999).

- University of Georgia (UGA): A university based in the United States with researchers in ethnobiology, anthropology, biochemistry, molecular biology, pharmacology, and other fields. Lead Researcher: Brent Berlin.
- El Colegio de la Frontera Sur (ECOSUR): The host institution in Chiapas with researchers in agroecology, population ecology, systematic botany, biomedicine, natural products chemistry, economics, and rural development.
- Molecular Nature Limited (MNL): A pharmaceutical firm with expertise in plant natural products chemistry, biochemistry, botany and business.

In the 1990s, the Maya ICBG was one of the major bioprospecting projects in Mexico and was designed to incorporate traditional knowledge into pharmaceutical research. The researchers had hopes of benefiting indigenous communities economically and technologically while conserving plants and TEK. Unfortunately, however, the Maya ICBG project experienced local and international opposition led by a local NGO (Non-Governmental Organization) of healers called the Council of Traditional Indigenous Doctors and Midwifes from Chiapas (COMPITCH) and a Canadian-based NGO called the Rural Advancement Foundation International (RAFI), who accused the project of exploiting indigenous people and privatizing their knowledge. The opposition claimed that commercially using medicinal plants conflicts with the collective traditions and religions of the Maya (Bjorkan & Qvenild, 2010).

Opposition to the Maya ICBG

The opposition consisted of two major groups who accused the project of biopiracy. They claimed bioprospecting in general, and particularly the Maya ICBG project's underlying motives, would lead to the privatization of indigenous knowledge and resources through the claiming of intellectual property rights or patents (Bjorkan & Qvenild 2010).

- Council of Traditional Indigenous Doctors and Midwives from Chiapas (COMPITCH): El Consejo de Médicos y Parteras Indígenas Tradicionales: a Mexican Non-profit organization comprised of native indigenous healers (ETC Group, 2001; Berlin & Berlin, 2004; Nigh, 2002; Rosenthal, 1997).
- Rural Advancement Foundation International (RAFI): Now the ETC Group, or the Action Group on Erosion, Technology, and Concentration. A Canadian NGO who opposed the establishment of the ICBG groups from the beginning (Berlin & Berlin, 2004).

Important Terms

- *Bioprospecting:* The search for chemical compounds within organisms from which commercially valuable compounds can be obtained.
- *Traditional Medicine (TM):* The sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness (World Health Organization. <http://www.who.int/medicines/areas/traditional/en/>).
- *Traditional Ecological Knowledge (TEK):* Indigenous knowledge passed orally between generations that provides information on the relationships between the people and their environment, including their use of biological resources.

- *Intellectual Property Rights (IPR):* Rights granted to a person or people over the knowledge they hold, giving them control over how it is used for a period of time.
- *Biopiracy:* Practice in which traditional ecological knowledge (TEK) is exploited for profit. This is done without consent from the indigenous people themselves and with little or no compensation or recognition.

List of Relevant Acronyms

CBD: Convention on Biological Diversity
COMPITH: Council of Traditional Indigenous Doctors and Midwives from Chiapas
ECOSUR: Mexican Institution El Colegio de la Frontera Sur
ICBG: International Cooperative Biodiversity Group
IMSS: Mexican Institute of Social Security
Maya ICBG: Maya International Cooperative Biodiversity Group
MLN: Molecular Nature Limited
NGO: Non-Governmental Organization
NIH: National Institutes of Health
NSF: National Science Foundation
PIC: Prior Informed Consent
PROMAYA: Protection of Maya Intellectual Property Rights
RAFI: Rural Advancement Foundation International
TEK: Traditional Ecological Knowledge
UGA: University of Georgia
USAID: United States Agency for International Development

Figure 1: Map of area. The red cirle indicates the Mexican state of Chiapas; the map detail in the left corner shows the municipalities of Chiapas, with the highlands in green. *Credit:* Derived from a work by Heraldry, CC BY-SA 3.0, <https://commons.wikimedia.org/wiki/File:Mexico_location_of_Chiapas.svg>.

Stage One

Getting Started (Brazil and the United States: 1992–1998)

The Convention on Biological Diversity (CBD) arose from the United Nations Summit on the environment in Rio de Janeiro, Brazil in 1992. The convention aimed to conserve and sustain biological resources and established that independent nations were to have absolute control over the resources within their boundaries (Berlin & Berlin, 2004). The CBD established a framework for how scientists involved with bioprospecting should think about concepts such as indigenous knowledge (Bjorkan & Qvenild, 2010). As stated in the CBD handbook, the CBD calls for the sustainable use and conservation of biological diversity and strives to secure a "fair and equitable sharing of benefits arising out of the utilization of genetic resources" as well as those benefits that arise from using indigenous knowledge, innovations, and practices (Secretariat of the Convention on Biological Diversity, 2005). The CBD emphasizes the preservation, protection, and maintenance of local and indigenous knowledge, innovations and practices and it allows the country of origin to restrict access to plant genetic material (Bjorkan & Qvenild, 2010). The same year that the CBD was established, the International Cooperative Biodiversity Group (ICBG) Program was developed by the National Institute of Health (NIH), the United States Agency for International Development (USAID) and the National Science Foundation (NSF) (Berlin & Berlin, 2004; Nigh, 2002; Rosenthal, 1997). The ICBG program was a United States funding program created to stimulate the field of bioprospecting while providing models for the sustainable use of biodiversity (Rosenthal, 1997).

From its inception, the ICBG required that three principal goals be included in proposals in order to be considered for funding: 1) to improve human health through the discovery of new therapeutic agents and treat diseases that are problematic in both the host country and the United States; 2) to conserve biodiversity by developing safe management methods for the biological resources being harvested and used; and 3) to promote sustainable economic activity of communities, particularly in less developed countries in which much of the world's biodiversity occurs. Each ICBG project was to be composed of an American academic institution, a local and international voluntary organization and a pharmaceutical company (Rosenthal, 1997).

Drs. Brent and Elois Ann Berlin, anthropology professors from the University of Georgia (UGA), responded to the first ICBG request for applications in 1992 (Berlin *et al.*, 1999). Their partners were the Mexican Institution El Colegio de la Frontera Sur in San Cristobal de Las Casas, Chiapas, Mexico (ECOSUR) and the Mexican Institute of Social Security (IMSS). Berlin's proposal was rejected due to the lack of a private industrial partner that was well suited to handle the large-scale pharmaceutical analysis that the team was proposing (Berlin & Berlin, 2004; Nigh, 2002). In 1997, the ICBG program once again began to accept project proposals. Dr. Brent Berlin and his team reapplied with a new partner, Molecular Nature Limited (MNL), a small British pharmaceutical company instead of the IMSS (Berlin & Berlin, 2004). The project was awarded a five-year grant and work began for the Maya ICBG in 1998 (Berlin & Berlin, 2004; Nigh, 2002; Soto, 2000).

The major goals of the Maya ICBG were: 1) discover, isolate, and evaluate agents from medicinal plants in Chiapas, Mexico; 2) discover, isolate and evaluate species with a significant potential to aid human health and the financial status of the Maya people; 3) initiate surveys of the plants in the Chiapas Highlands by municipality in Spanish and the most common Maya languages in southern Mexico; and 4) enhance and support research training relevant to ECOSUR's goals by developing a modern natural products laboratory to advance drug discovery and strengthening academic exchange between the University of Georgia and Mexico (Berlin *et al.*, 1999).

Questions

1. What are the reasons behind entities of the United States Government (NIH, USAID, and NSF) funding the development of the ICBG program in less developed countries?
2. What ethical consequences should be considered when investing in the ICBG project?
3. Think of the process of bioprospecting overall. What are the local and global benefits of bioprospecting traditional knowledge held by indigenous people, and what may be some of the negative impacts?

Stage Two

Hard at Work (Chiapas, Mexico: 1998–1999)

The location for this project was chosen based on the principal investigator's previous work with the highland Chiapas Maya communities (Berlin & Berlin, 2004; Nigh, 2002). Dr. Brent Berlin had conducted ethnobotanical research with the Tzeltal and Tzotzil since the 1960s (Bjorkan & Qvenild, 2010) and built upon those decades of friendship to establish new relationships with other local communities (Berlin & Berlin 2004; Berlin *et al.,*1999). Within those communities, Berlin and the Maya ICBG team shared the goal of providing a local laboratory and training community members, and well as keeping inventory of all plant species that were used by the community as medicine. A basic medicinal kit with 100 plants for specific illnesses was to be made and medicinal plant gardens installed. One of the project's goals was to return 25% of the revenues to local communities, including those who did not take part in the project but had similar botanical resources and knowledge (Berlin & Berlin, 2004; Bjorkan & Qvenild, 2010).

There are approximately 8,000 villages and 900,000 Maya in the highland communities of Chiapas (Rosenthal, 2006; Bjorkan & Qvenild, 2010), Not only are these communities poverty-ridden and divided by religious and political conflict, but they also lack local authorities that are allowed to speak on behalf of all community members (Bjørkan & Qvenild, 2010). The Maya ICBG was required to obtain informed consent of the communities that were to be involved, but the nature of the communities made it exceptionally challenging to acquire this permission. Berlin & Berlin (2004) argued that the project went through an extensive process of obtaining prior informed (PIC) from the communities based on the CBD guidelines for ethnical bioprospecting research. As a result of the suggestions made by the Mayan research assistants, the Maya ICBG decided to develop a theatrical performance designed to explain the project to the community leaders in their native languages (Berlin & Berlin, 2004). The skits included information about the overall purpose of the project, the manner in which information would be collected, and the procedures that would be used on the biological material gathered (Berlin & Berlin, 2004). Leaders from 47 communities along with the Council of Traditional Indigenous Doctors and Midwives from Chiapas (COMPITCH) were invited to see the presentation and tour the labs and gardens located at ECOSUR (Berlin & Berlin, 2004; Nigh, 2002; Soto, 2000). The attendees were then provided with bilingual (Spanish and the indigenous language) summaries of the project goals, activities and proposed benefit sharing program (Berlin & Berlin, 2004).

Once the presentations and information had been given to all attendees, they were then asked to return to their respective communities and discuss in community assemblies the possibility of participating in the project. The Maya ICBG was then to be invited to perform the skits at each individual community that was interested. The Maya ICBG group visited each community to give their performance over a three-month period (Bjorkan & Qvenild, 2010). Elections were then held by each community and 46 out of 47 communities agreed to participate (Berlin & Berlin, 2004). Participants were then asked to sign formal agreements, although the individuals who signed varied by community since the ICBGs request for proposals stated that all projects were to respect local customs (Berlin & Berlin, 2004; Rosenthal, 1997). Those who signed the consent forms ranged from heads of households to elected community leaders (Berlin & Berlin, 2004).

After consent was given, the Maya ICBG planned to establish a nonprofit association comprised of individuals selected by the communities involved to distribute any future revenue. The association was to be known as the Protection of Maya Intellectual Property Rights (PROMAYA) (Berlin & Berlin, 2004; Soto, 2000). Profits from the commercial products developed were to be distributed among all collaborators equally (ECOSUR, UGA, MNL, PROMAYA). Funds for PROMAYA would be used to develop community herbal gardens, scholarships, and other significant activities to improve social and cultural well-being (Berlin & Berlin, 2004). Project leaders were advised by their collaborators to understate the financial benefits during the initial presentations in order to avoid raising unrealistic expectations among the communities (Berlin & Berlin, 2004).

Although the actions taken by the Maya ICBG in terms of PIC were meant to maintain harmony among participating members, as time went on, several organizations having no connection to the project began to question their activities.

Questions

1. If you were a member of a local Chiapas community, how would you feel about your community's involvement with the Maya ICBG project, and why?

2. The Chiapas community learned about the Maya ICBG project through a theatrical performance. List reasons why this is an effective approach. List reasons why this is not an effective approach.

3. Assume that your community decides to be involved with the Maya ICBG project. Which member(s) of the community should be responsible for giving consent to share your community's traditional knowledge?

4. At this point in the case study, is there reason to believe that the project's original intentions would be fulfilled? Is there reason to suspect that those intentions would not be met?

Stage Three

The Opposition Reacts (Mexico, Canada and United States: 1999–2000)

During the first stages of the project, the Maya ICBG acknowledged COMPITCH and the significant role that it played in the project's development. The researchers presented COMPITCH with documents describing the project and invited them to participate. COMPITCH immediately rejected the project and argued that there was a lack of regulations designed for bioprospecting in Mexico. Their perspective was that the project should not continue until such federal regulations were formulated, and stated that the Maya ICBG should guarantee no activities would occur until such regulations were in place (Nigh, 2002).

After several months, confronted with the absence of regulations by the Mexican federal government, the Maya ICBG proceeded to work within the existing laws (Nigh, 2002), including the need to obtain consent from communities on whose lands collection of plants would be made (Anderson *et al.,* 2002; Berlin & Berlin, 2004; Nigh, 2002). In hopes of preventing the study from going forward, COMPITCH pursued a partnership with a Canadian NGO, the Rural Advancement Foundation International (RAFI) to run a campaign against the Maya ICBG (Berlin & Berlin, 2004; Nigh, 2002; Rosenthal, 2006). RAFI had a well-established reputation due to its opposition of a previous ICBG in Peru. (Berlin & Berlin, 2004; Rosenthal, 1997). RAFI claimed that even though COMPITCH had an exclusive guild of healers with an established for-profit medicinal plant business, they spoke for all local indigenous communities of the highlands (Berlin & Berlin, 2004).

There is disagreement over how prior informed consent (PIC) was acquired in the Maya ICBG. Typically, when researchers would like to work with indigenous people, they must obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them, including measures that may affect indigenous peoples' rights to land, territory and resources (OHCHR, 2013). Those opposing the Maya ICBG project argued that the authorizations obtained were unacceptable or invalid in terms of all three components of PIC: What determines "prior"? Who should be "informed" and how? And who can give "consent"?

When it comes to the subject of "prior," the United Nations High Commissioner for Human Rights stated that consent is sought sufficiently in advance of any authorization or commencement of activities, and that respect is shown to the time requirements for the indigenous communities to adequately consult among themselves (OHCHR, 2013). In this instance, the opposition claimed that samples of botanical resources were obtained by the Maya ICBG before authorizing signatures were acquired (Hardison, 2000).

When the aspect of "informed" is examined, the opposition claimed that there was a bias when presenting the project activities to the local communities (Hardison, 2000). They stated that the Maya ICBG failed to inform the entire community through official assemblies and instead informed individual families through the theater performances. They argued that there was also a failure to disclose all possible local and global impacts the project might have (Hardison, 2000). Some examples of the impacts that were said to not have been disclosed according to the opposition are the possibility that confidential information held by the Maya ICBG partners could become property of another company; or that land once used for local food crops could be used commercially to grow plants for pharmaceuticals, negatively impacting food security (ETC Group, 2001).

Furthermore, the issue of "consent" comes in to question. The opposition challenged the Maya ICBG's claim of having written consent from all participating members, suggesting the locals were not adequately informed (Hardison, 2000). Those who opposed the project also declared that the participating communities had no power to give consent over biological resources that might be shared among many communities, in which case all communities should have been approached (Berlin & Berlin, 2004; Hardison, 2000).

In addition, RAFI accused the Maya ICBG of selecting community participation only from municipalities that were sympathetic to the Mexican government and heavily affected by military repression, with parts of the population forcefully removed from their homes for sympathizing with a community uprising (RAFI, 2000; Bjorkan & Qvenild, 2010). RAFI also questioned the legitimacy of PROMAYA, arguing that the Maya ICBG project created a partner that

would not question its research approach. RAFI and COMPITCH believed that the Maya ICBG manipulated the communities who agreed to take part in the project (Bjorkan & Qvenild, 2010).

RAFI and COMPITCH argued that the PIC that the Maya ICBG obtained did not adequately represent the communities that they worked with and that there was a lack of respect for the local historical processes for decision-making (Bjorkan & Qvenild, 2010). When biological resources and knowledge are shared by multiple communities, RAFI and COMPITCH argued that under such conditions, an individual community should not formulate valid agreements for contributing knowledge and for allowing research and use of natural resources within its territory. They argued that having only some communities sign off on the agreement would violate the rights of the other communities where the same plants may be found and used. Therefore, they argued that permission to conduct research must be granted by all relevant communities that share the knowledge (Berlin & Berlin, 2004). The opposition declared the Maya ICBG had a hidden agenda (ETC Group, 2001; Nigh, 2002). Rather than bioprospecting for the wellbeing of the community and human health, the Maya ICBG was accused of attempting biopiracy (ETC Group, 2001; Berlin & Berlin, 2004). In fact, the opposition claimed that 99% of the profits from the project would probably go to the multinational pharmaceutical company producing the medicine based on traditional ecological knowledge (TEK) (Bjorkan & Qvenild, 2010).

In response to these complaints, the Maya ICBG members stated that they chose to seek consent from the communities within municipalities that had control over the land they inhabited and over the resources available within those boundaries (Anderson *et al.,* 2002). The Maya ICBG also argued that one of the primary purposes of the CBD 1992 treaty on biodiversity was to allow knowledge that is shared among communities or across national boundaries to be considered as public domain (Berlin & Berlin, 2004: 479). Through this structure, knowledge about plants and their medicinal applications is publicly available, accessible to all individuals and not subject to intellectual property laws, as the opposition had claimed (Berlin & Berlin, 2004).

Members of the Maya ICBG stated that their project was designed to preserve biodiversity and local knowledge, as well as to provide economic benefits to the communities of Chiapas. Importantly, Berlin and Berlin (2004: 481) claimed that "… local indigenous community autonomy, as envisioned in the CBD, is more a myth than reality in the access of biological resources debate, especially in the politically charged climate of Mexico and Latin America. Most local communities are not members of representative, democratically organized federations, organizations, or 'Indian nations'." They argue that this structure makes the groups vulnerable to NGOs that can assume the role of representing them (Berlin & Berlin, 2004).

Questions

1. What is the actual evidence produced by the opposition (COMPITCH and RAFI) about the project?

2. What evidence did the Maya ICBG provide in defense to what was said about the project?

3. What role do you feel that the Mexican government should play in responding to the controversy?

4. Given the deficient regulatory framework pertaining to PIC in Mexico, how do you view the ICBG actions taken in order to achieve consent?

Stage Four

The Project Comes to an End (Mexico and United States: 2000–2001)

Amid growing opposition, the Maya ICBG continued to argue that the indigenous people would have great benefits from the project including the documentation of their plant knowledge, the most modern procedures available in natural products science, and the development of a sustainable resource management and production system that would benefit the highland Maya's health and economy (Berlin & Berlin, 2004), In spite of the arguments defending the project, the Maya ICBG was asked by the governor of Chiapas to redesign their project's methods, having their work come to a standstill (ETC Group, 2001; Berlin & Berlin, 2004). For the remaining three years of the grant, the NIH allowed the project focus to shift to developing new procedures for obtaining PIC. The new plan included summer-long workshops to familiarize the indigenous Maya on environmental policy that were to be led by Mexico's prominent biodiversity experts (Berlin & Berlin, 2004). The design was then presented to those who opposed the project by the Mexican government on August 2001 (ETC Group, 2001; Berlin & Berlin, 2004; Nigh, 2002). However, due to all of the negative publicity, the project's host institution ECOSUR withdrew, citing the lack of laws and regulations as their reason for doing so. The project ended in October 2001 (ETC Group, 2001; Anderson *et al.,* 2002; Nigh, 2002). At this time, the opposition gained more followers including Mexican intellectuals and other international NGOs such as Global Exchange (Berlin & Berlin, 2004).

The opposition portrayed the Maya ICBG project as an example of how the United States was trying to exploit Mexico, how scientists stole TEK, and how indigenous rights were being usurped (Berlin & Berlin, 2004). As Bjorkan & Qvenild (2010) stated, the scientists associated with the Maya ICBG and the NGO opposition (RAFI and COMPITCH) both claimed to have the best interests of the indigenous communities in mind. While the Maya ICBG wanted to bring development and knowledge preservation to the poor indigenous communities, the NGOs wanted to protect the indigenous culture, knowledge, and biological resources from "biopiracy and the greedy scientists" (Bjorkan & Qvenild, 2010: 198). When RAFI and COMPITCH described the Maya ICBG project widely through the Internet, email and print media, their message found a receptive international audience and eventually caused the demise of the project.

Questions

1. Do you think that the NIH's approach to the opposition was appropriate? Why or why not?

2. Should the Maya ICBG have been responsible for constructing new methods for obtaining consent instead of continuing their study? Why or why not?

3. List possible actions that the Maya ICBG could have put in place that would have changed the outcome of this project to satisfy all parties.

Conclusion

PIC Laws and Regulations

After the events that occurred within the Maya communities, COMPITCH began developing their own proposals for research. One of their main concerns was to make sure their knowledge was not being used by foreign corporations (ETC Group, 2001; Nigh, 2002).

Resolving legal and ethical dilemmas such as that of PIC may prove to be problematic, since no single standard law will easily suit all international ventures. Steps towards achieving this goal have only been attempted in locations where the communities are all recognized to be part of one larger, cohesive community or there is a single accepted governing body (Hardison, 2000).

Many countries such as Mexico do not have laws established to protect the TEK of indigenous communities (Andrzejewski, 2010; Garcia, 2007). Under Mexico's current laws only new inventions or knowledge having a single inventor, not communities, are able to be claimed and patented (Garcia, 2007). TEK generally has no known single inventor so that it is not considered patentable, preventing any bioprospecting to go on to its final phase (Rosenthal, 1997). Due to TEK being considered "new knowledge" to foreigners outside the indigenous communities, foreign companies can obtain patents on TEK while the indigenous creators cannot (Garcia, 2007). To resolve this problem and empower future bioprospecting projects in Mexico, the Mexican government must establish laws on the sharing and usage of TEK within and beyond its borders.

References

Abbott, R. 2014. Documenting traditional medical knowledge. World Intellectual Property Organization. Web. Accessed June 3, 2016 at <http://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical_tk.pdf>.

Anderson, E., B. Berlin, E.A. Berlin, and J.R. Stepp. 2002. On Maya medicine and the biomedical gaze. *Current Anthropology* 43(3): 789–793.

Andrzejewski, A. 2010. Traditional knowledge and patent protection: conflicting views on international patent standards. *PER: Potchefstroomse Elektroniese Regsblad* 13(4): 94–125. Accessed June 23, 2016 at <http://www.scielo.org.za/pdf/pelj/v13n4/v13n4a05.pdf>.

Barrett, B., D. Kiefer, and D. Rabago. 1999. Assessing the risks and benefits of herbal medicine: an overview of scientific evidence. *Alternative Therapies in Health and Medicine* 5(4): 40–49.

Berlin, B., and E.A. Berlin. 2004. Community autonomy and the Maya ICBG Project in Chiapas, Mexico: how a bioprospecting project that should have succeeded failed. *Human Organization* 63(4): 472–486.

Berlin, B., E.A. Berlin, J.C.F. Ugalde, L.G. Barrios, D. Puett, R. Nash, and M. González-Espinoza. 1999. The Maya ICBG: drug discovery, medical ethnobiology, and alternative forms of economic development in the highland Maya region of Chiapas, Mexico. *Pharmaceutical Biology* 37(4): 127–144.

Bjørkan, M., and M. Qvenild. 2010. The biodiversity discourse: categorisation of indigenous people in a Mexican bioprospecting case. *Human Ecology* 38(2): 193–204.

ETC Group. 2001. Proyecto de biopiratería en México cancelado definitivamente. Accessed May 31, 2016 at <http://www.etcgroup.org/sites/www.etcgroup.org/files/publication/233/01/news_sp_icbg_nov2001.pdf>.

Garcia, J. 2007. Fighting biopiracy: the legislative protection of traditional knowledge. *Berkeley La Raza Law Journal* 18(2): 5–28.

Hardison, P. 2000. ICBG-Maya: a case study in prior informed consent. *The Monthly Bulletin of the Canadian Indigenous Caucus on the Convention on Biological Diversity* No. 16. Accessed June 23, 2016 at <http://trade.ec.europa.eu/doclib/docs/2005/april/tradoc_122178.pdf>.

Nigh, R. 2002. Maya medicine in the biological gaze: bioprospecting research as herbal fetishism. *Current Anthropology* 43(3): 451–477.

OHCHR (Office of the United Nations High Commissioner for Human Rights). 2013. Free, prior and informed consent of indigenous peoples. Accessed July 11, 2016 at < http://www.ohchr.org/Documents/Issues/IPeoples/FreePriorandInformedConsent.pdf>.

Rosenthal, J. 1997. Integrating drug discovery, biodiversity conservation, and economic development: early lessons from the International Cooperative Biodiversity Groups. Pp. 281–301 in: F. Grio and J. Rosenthal (eds.), *Biodiversity and Human Health*. Island Press, Washington, D.C.

Rosenthal, J. 2006. Politics, culture, and governance in the development of prior informed consent in indigenous communities. *Current Anthropology* 47(1): 119–142.

Secretariat of the Convention on Biological Diversity. 2005. *Handbook of the Convention on Biological Diversity: including its Cartagena Protocol on Biosafety*, 3rd ed. Montrel: UNEP. Available at <http://www.cbd.int/doc/handbook/cbd-hb-all-en.pdf>.

Soto, J.C. 2000. Pukuj: Biopiratería en Chiapas. Accessed May 31, 2016 at <http://www.otrosmundoschiapas.org/analisis/BCEPCGMAYA.pdf>.

Vogel, J.H., ed. 2010. *The Museum of Bioprospecting, Intellectual Property, and the Public Domain: A Place, A Process, A Philosophy.* Anthem Press.

Additional Resources

Balick, M.J., and P.A. Cox. 1997. *Plants, People, and Culture: The Science of Ethnobotany.* W.H. Freeman & Company.

Lira, R., A. Casas, and J. Blancas. 2016. *Interactions of People and Plants in Mesoamerica.* Springer International Publishing.

Musgrave, T, W Musgrave. An Empire of Plants: People and Plants that Changed the World. Cassell, 2000.

Olson, E. 2014. *Indigenous Knowledge and Development: Livelihoods, Health Experiences, and Medicinal Plant Knowledge in a Mexican Biosphere Reserve*. Lexington Books, 2014.

Rus, J., R. Aida, and H. Castillo, eds. 2013. *Mayan Lives, Mayan Utopias: The Indigenous Peoples of Chiapas and the Zapatista Rebellion (Latin American Perspectives in the Classroom).* Rowman & Littlefield Publishers.

Simpson, B.B., and M. Conner-Ogorzaly. 2000. *Economic Botany: Plants in Our World*, 3rd ed. McGraw-Hill.

All internet references accessible as of February 1, 2018.