"Space as a tool to address climate challenges: an example from the Alvarado Lagoon System in Mexico"

Abstract

The Alvarado Lagoon System is the second largest mangrove forest in Mexico. It provides ecosystem services such as climate regulation and fisheries, the latter considered as an important source of income for coastal communities. Local NGOs face challenges in the maintenance of long term ecological and geo-referenced photographic monitoring. Strengthening synergies among the UNOOSA and the CBD could be key in the new Global Biodiversity Framework Post 2020, placing emphasis on the role of local NGOs in the conservation of biodiversity as a basis for thriving societies in a global climate change context.

Keywords: space-based technologies, biodiversity, climate change, mangroves.

Introduction

Once known as *Atlizintla,* which means "next to abundant water", in the Mexican coast lies *Alvarado*, a city surrounded by a lagoon system home to the second largest mangrove forest in Mexico.

Designated a Ramsar site in 2004, the area´s rich biodiversity supports one of the most productive lagoon systems in the Gulf of Mexico. 40% of fish species are used as an economic resource in an area where fisheries has shaped the bio-cultural diversity[1] and heritage of ancient and contemporary people in Veracruz, Mexico.

[1] Bio-cultural diversity includes biological diversity (genes, species and ecosystems), as well as cultural diversity in all its manifestations (including linguistic diversity), as well as the interactions among all of these (Loh and Harmon, 2005).

Also, it is home to mammals such as the manatee (*Trichechus manatus*), and around 377 birds benefit from this mangrove ecosystem (Portillo Ochoa et al., 2020).

Nowadays, the Alvarado Lagoon System (ALS) faces many threats such as deforestation resulting particularly from agriculture and cattle; intensive fishing activities; expanding urban and tourism zones; and poor waste management practices (Castañeda and Contreras, 2001; Cruz-Escalona et al., 2007).

Mangroves provide many environmental services to society and play an important role in climate change mitigation and adaptation (Flint et al., 2018). Some of these services are water provision, climate regulation, materials such as wood, and coastal protection. They have proven to provide defense from natural hazards such as storms and floods, and capture carbon dioxide (Rodríguez-Zúñiga, et. al. 2013), strengthening local communities' resilience to climate change.

This essay presents the challenge of a local NGO in the ALS in order to monitor and assess the effectiveness of the *chinampa* ancient technique, for which accessible earth observation technologies are needed in order to collect data on a regular basis. In this regard, international cooperation could be strengthen so space-based technologies support mangrove ecosystems, relevant for mitigating climate change.

Space-based technologies for the resilience of local communities and ecosystems

There have been several efforts to protect, conserve, restore and promote the sustainable use of the ALS wetlands. In 2015, a project carried out by the non-governmental organization (NGO) *Pronatura Veracruz* and the Institute for Ecology and Climate Change of Mexico, led the successful restoration of 25 hectares of mangroves in a lesser time and with lower costs in comparison to governmental programs in the past. This was successfully carried out through the establishment of private conservation areas and communal environmental management areas, involving local women and men who received technical training for restoration (Rodriguez de los Santos, 2019).

The activities within the project also aimed to foster more diversified livelihoods, through the promotion of the sustainable use of mangrove wood in order to produce and commercialize coal, while preserving ecosystem services that benefit local people and provide support in the mitigation and adaptation to climate change.

In 2018, *Pronatura Veracruz,* the organization that has been restoring the area since 2006, was granted with the Ramsar Convention Award for Wetland Innovation, rewarding innovative techniques that contribute to the wise use of wetlands.

The restoration was accomplished using the *chinampas* technique. A *chinampa* is a raised field on a small artificial island on a freshwater lake surrounded by canals and ditches that was developed during the time of the Aztecs (Ebel, 2019) and that allows propagules[2] to thrive easier.

In this sense, ecological monitoring and geo-referenced photographic monitoring was crucial to assess the evolution of growth of seedlings. Notwithstanding, vigilance and monitoring represent a challenge as the maintenance of long term funding is needed. Investment in staff, infrastructure and technical equipment is key but limited (Rodriguez de los Santos, 2019).

Earth observations and satellite images are crucial for monitoring and assessment. Demonstrating the effectiveness of the results of projects is decisive in order to continue implementing more conservation measures.

Specialized unmanned aerial vehicles were used during this project, nevertheless these are highly expensive. Additionally, more specialized tools are needed as time goes by; restoration and monitoring can not end with a project. On the other hand, satellite images are not available for this region in a consistent way so regular monitoring could not be done.

---

[2] A vegetative structure that can become detached from a plant and give rise to a new one.

Providing opportunities to NGOs to access these technologies, especially to data from Earth observation satellites and the benefits of Global Navigation Satellite Systems (GNSS) on a regular basis, would support mangroves management, whilst providing more data on biodiversity status and ecosystems dynamics with the aim to tackle climate change and improve people´s livelihoods.

Conclusions

2020 is known as the year of biological diversity. There is currently a draft of the new biodiversity framework post 2020 that is under negotiation within the members and stakeholders of the Convention on Biological Diversity. One of the major challenges, as expressed by many countries is the definition and consensus on baselines for setting biodiversity goals and targets (CBD, 2020), for which space-based technologies could play a decisive role.

Nowadays, the document does not include any explicit reference to the utilization of these technologies in order to address the afore mentioned. This opens a possibility to not only strengthen United Nations agencies and biodiversity-related conventions synergies, but the exceptional opportunity to have United Nations Office for Outer Space Affairs as a major partner for the implementation and assessment of the post-2020 biodiversity goals, placing emphasis on the important role of NGOs as partners in the use of space-based technologies in order to generate scientific data.

Biodiversity is central in a global context of climate change. It is a recipient of negative effects, but also a solution for mitigation and adaptation. Ecosystems such as wetlands are a "critical element for avoiding dangerous changes to the Earth's atmospheric temperature and climate system" (CBD, n/d). Sustainable Development Goals (SDGs) 14 and 15 provide the essential ecosystem services which are the basis for the accomplishment of the rest of SDGs. We need a thriving biosphere, in order to successfully have thriving societies and economies.

References

Castaneda, L., Contreras, (2001). F. Serie: Bibliografia Comentada sobre ecosistemas costeros mexicanos. Centro de Documentacion Ecosistemas Litorales Mexicanos. Universidad Autonoma Metropolitans, Unidad Iztapalapa, Division C.B.S. Depto. De Hidrologica. Publicacion electronica (CD), Mexico, D.F., ISBN: 970-654-912-9.

CBD, (n/d). Biodiversity and the 2030 Agenda for Sustainable Development: Technical Note. Retrieved from: https://www.cbd.int/development/doc/biodiversity-2030-agenda-technical-note-en.pdf

CBD, (2020). UN Doc. CBD/WG2020/REC/2/1. Recommendation adopted by the Open-ended Working Group on the Post 2020 Global Biodiversity Framework, 24-29 February 2020. Retrieved from: https://www.cbd.int/doc/recommendations/wg2020-02/wg2020-02-rec-01-en.pdf

Cruz-Escalona V, Arreguin-Sanchez F, Zetina-Rejon M. (2007). Analysis of the ecosystem structure of Laguna Alvarado, western Gulf of Mexico, by means of a mass balance model. Estuar. Coast. Shelf Sci 2007;72:155–67. https://doi.org/10.1016/j.ecss.2006.10.013

Ebel, R. (2019). Chinampas: An Urban Farming Model of the Aztecs and a Potential Solution for Modern Megalopolis. *HortTechnology*, 30(1), pp.13-19. Retrieved from: https://journals.ashs.org/horttech/view/journals/horttech/30/1/article-p13.xml

Flint, R., D. Herr, F. Vorhies and J. R. Smith (2018). Increasing success and effectiveness of mangrove conservation investments: A guide for project developers, donors and investors. IUCN, Geneva, Switzerland, and WWF Germany, Berlin, Germany. (106) pp. pp22 retrieved from: https://www.iucn.org/sites/dev/files/content/documents/wwf-iucn-mangrove_investments_final-002.pdf

Loh, J., & Harmon, D. (2005). A global index of biocultural diversity. Ecological Indicators, 5(3), 231–241. doi:10.1016/j.ecolind.2005.02.005.

Portillo Ochoa, E., Cortina Julio, B., Sánchez Hernández, A., Juarez Eusebio, A. and Negrete Guzmán, C., (2007). Fortalecimiento de capacidades locales para la conservación del sitio Ramsar "sistema lagunar de Alvarado", Veracruz, México. Gonzalo Halffter, Sergio Guevara & Antonio Melic, p.258. Retrieved from: http://sea-entomologia.org/PDF/PDFSM3MVOL6/Pdf26255262026Portillaetal.pdf

Ramsar Secretariat. (2018). *2018 AWARDS*. Retrieved from Ramsar Wetland Conservation Award 2018: https://www.ramsar.org/activities/2018-awards

Rodriguez de los Santos, A. (2019). *PANORAMA*. Retrieved from Restoring mangroves in communal and private land supported by government management schemes: https://panorama.solutions/es/node/3298

Rodríguez-Zúñiga, M.T., Troche-Souza C., Vázquez-Lule, A. D., Márquez-Mendoza, J. D., Vázquez- Balderas, B., Valderrama-Landeros, L., Velázquez-Salazar, S., Cruz-López, M. I., Ressl, R., Uribe-Martínez, A., Cerdeira-Estrada, S., AcostaVelázquez, J., Díaz-Gallegos, J., Jiménez-Rosenberg, R., FueyoMac Donald, L. y Galindo-Leal, C. (2013). Manglares de México/ Extensión, distribución y monitoreo. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México D.F. 128 pp. Retrieved from: https://agua.org.mx/wp-content/uploads/2014/02/Manglares-de-M%C3%A9xico-Extensi%C3%B3n-distribuci%C3%B3n-y-monitoreo.pdf