

Current progress of the Caribbean flamingo conservation programme in Mexico

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Abstract

The Caribbean flamingo (*Phoenicopterus ruber*) is an emblematic species of the Yucatan Peninsula. Its conservation has resulted from historical efforts taken by multiple participants for 25 years. For more than 15 years, the Fundación Pedro y Elena Hernández has been a key force behind the conservation of this flamingo species and its habitat. Currently, Fundación operates the Flamingo Conservation Program in Mexico, in close technical and financial coordination with the federal government through the National Commission of Natural Protected Areas. Two main components form the program: The first to monitor the species and the second as community endeavour to raise awareness of the birds (and their environment) and promote environmental education. Recently, we have made improvements to the programme and the reviewed its principles. Forthcoming discussion on the conservation programme will involve many other relevant stakeholders, such as academics and NGOs and other parties, with links to the federal government. To this end, resources have been invested in the compilation, analysis and integration of multiple data sources. This phase has led to the construction of an information platform specialising in the Caribbean flamingo, which will soon be accessible to relevant users so they can perform a variety of analyses using all available information. In the educational and social branches of the program we have created innovative projects, seeking new spheres of action and educational tools for the local population to empower them to play a leading role in the conservation of this flamingo and its ecosystem. This document aims to update the status of the actions carried out in recent years, highlighting a series of achievements and perspectives for this important conservation programme in Mexico.

Resumen

El flamenco caribeño (*Phoenicopterus ruber*) es una especie emblemática de la península de Yucatán. Su conservación ha sido el resultado de los esfuerzos históricos realizados por múltiples participantes durante 25 años. Durante más de 15 años, la Fundación Pedro y Elena Hernández ha sido una fuerza clave detrás de la conservación de esta especie de flamenco y su hábitat. Actualmente, la Fundación opera el Programa de Conservación de Flamencos en México, en estrecha coordinación técnica y financiera con el gobierno federal a través de la Comisión Nacional de Áreas Naturales Protegidas. Dos componentes principales forman el programa: el primero para monitorear las especies y el segundo como trabajo comunitario para crear conciencia sobre las aves (y su entorno) y promover la educación ambiental. Recientemente, hemos realizado mejoras en el programa y revisamos sus principios. La próxima discusión sobre el programa de conservación involucrará a muchas otras partes interesadas relevantes, como académicos y ONG y otras partes, con vínculos con el gobierno federal. Con este fin, se han invertido recursos en la compilación, análisis e integración de múltiples fuentes de datos. Esta fase ha llevado a la construcción de una plataforma de información especializada en el flamenco del Caribe, que pronto estará disponible para los usuarios relevantes para que puedan realizar una variedad de análisis utilizando toda la información disponible. En las ramas educativas y sociales del programa, hemos creado proyectos innovadores, buscando nuevas esferas de acción y herramientas educativas para que la población local

los capacite para desempeñar un papel de liderazgo en la conservación de este flamenco y su ecosistema. Este documento tiene como objetivo actualizar el estado de las acciones llevadas a cabo en los últimos años, destacando una serie de logros y perspectivas para este importante programa de conservación en México.

Résumé

Le flamant des Caraïbes (*Phoenicopterus ruber*) est une espèce emblématique de la péninsule du Yucatan. Sa conservation a été le résultat d'efforts historiques déployés par de nombreux participants pendant 25 ans. Depuis plus de 15 ans, la Fondation Pedro et Elena Hernández est l'un des moteurs de la conservation de cette espèce et de son habitat. Actuellement, la Fondation gère le programme de conservation des flamants au Mexique, en étroite coordination technique et financière avec le gouvernement fédéral par le biais de la Commission nationale des aires protégées. Le programme comprend deux volets principaux: le premier pour surveiller l'espèce et le second en soutenant le travail communautaire pour sensibiliser les oiseaux (et leur environnement) et promouvoir l'éducation environnementale. Récemment, nous avons apporté des améliorations au programme et révisé ses principes. Les prochaines discussions sur le programme de conservation impliqueront de nombreuses autres parties prenantes, telles que des universitaires, des ONG et d'autres parties prenantes, ayant des liens avec le gouvernement fédéral. À cette fin, des ressources ont été investies dans la compilation, l'analyse et l'intégration de multiples sources de données. Cette phase a conduit à la construction d'une plateforme d'information spécialisée sur le flamant rose des Caraïbes, qui sera bientôt accessible aux utilisateurs concernés afin qu'ils puissent effectuer diverses analyses en utilisant toutes les informations disponibles. Dans les volets éducatifs et sociaux du programme, nous avons créé des projets novateurs, à la recherche de nouveaux domaines d'action et d'outils pédagogiques destinés à la population locale afin de lui donner le pouvoir de jouer un rôle moteur dans la conservation de ce flamant et de son écosystème. Ce document vise à mettre à jour l'état des actions menées au cours des dernières années, en soulignant une série de réalisations et de perspectives pour cet important programme de conservation au Mexique.

Permanent monitoring

Estimating total population of flamingos in the Yucatan Peninsula using remote sensing techniques and GIS

The population of flamingos in Yucatan has been estimated for more than 15 consecutive years from the indirect observation and visual "on the fly" estimations of experts using aerial platforms. This method conveys a high degree of subjectivity because depends on the skills, the experience and even visual capability of the observers; on the other hand, there is no organized historical photographic or tabular databases of all those surveys. Therefore, the available information lacks uncertainty

evaluation and, regional movements have been not considered when the estimation is stated. The results then, shows a high inconsistency, ranging from 15 000 to 80 000 individuals among years.

The lack of periodicity of the surveys, the accessibility and organization of the original data and the changeability of personnel that performed estimations. Due to the relevance of this permanent exercise, we implemented remote sensing techniques based on videography (with 4K cameras) and aerial photography with high spatial resolution (10 cm), integrated to Geographic Information Systems to reduce uncertainty factor and consequently simplify data processing and

subjectivity. With these aerial camera's configuration, we began to generate more robust geospatial data series, along with precision reports.

This allows us to make reliable data management for diverse purposes such as supporting reports and governmental reports about the status species, or supporting decision-making during emerging phenomena such as drought, among others. Though, the human factor is still important since the quantification of the most dispersed groups of individuals is still estimated by well-trained specialists, sometimes contributing up to 10 % of the total quantification. The generation of the data series is unique and perhaps unprecedented. Under a GIS environment, the construction of *semi-controlled* mosaics, facilitating the visual and *semi-automated*

identification and mapping distribution and density of flamingos at a given moment in great detail (see Figure 1). With this methodology with an overall precision of 90%, we obtained during 2018 reproductive cycle (16 August) 20,587 individuals, while in the winter season (22 November), the result was 13,240 members. Finally, at the beginning of current year's breeding season (February 26), we counted 18,711 individuals. Globally, we have flown the northern coast of the Peninsula about ten occasions, accumulating a total of 4,200 km, surveying twice per year. The potential of having this kind of data integrated into a GIS platform is so promising; many experts could be establishing new specific analysis such as relating flamingo's distribution habitat with climatic change scenarios.

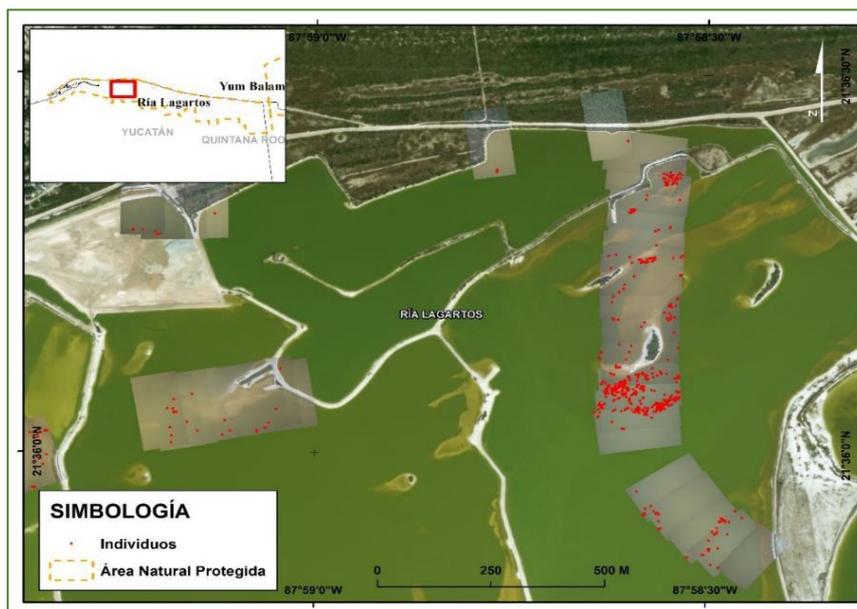


Figure 1: Construction of mosaics into GIS for mapping and counting individual flamingos. This survey was done using high-resolution aerial videography. The figure shows the distribution of flamingos in Ría Lagartos (09:30 hours; November 22, 2018). Each individual is integrated in the GIS database as a single unrepeatable entity (one point) linked to an attribute table containing more features of each individual (feather colour, estimated height, etc.)

Field counting routines integrating drones and photogrammetric techniques

In order to monitor the species in the field along the Peninsula, we have continuing with "direct" field observations routines. In the last

4 years there have been about 48 fieldtrips, accumulating nearly 500 transects in the preferential areas of flamingos. The field method was complemented by recording of aerial images obtained using a drone. This device has also served as a prospective

instrument on large and inaccessible surfaces. It has allowed us to generate visual perspectives of previously unrecorded flocks; it also makes it easier and more precisely counting population at each site. This aerial camera has enabled us to register the

presence of feral dogs attacking the tiny reproductive colony in 2017, in the protected Area "El Palmar". Below are two images generated with this tool and remote sensing technique (Figure 2).



Figure 2: Concentration of flamingos in El Palmar State Reserve (left) and an image to analyse the density of nest occupancy in the breeding colony (right) in 2017.

Deployment of satellite *geotrackers* in adult flamingos

It is known from different sources that individuals of banded flamingos in Mexico have been found in the Caribbean Islands and other countries of the Region; it has been established that the population of flamingos studied in Mexico is part of a larger population or *meta-population*, and that this population moves throughout the Caribbean (Gálvez et al. 2016), including the southwestern part of the United States and Central America. In order to contribute to better understanding the regional movements of the population, Fundación implemented since late 2017, geo-tracking deployment in the species using satellite geo-transmitters linked to ARGOS infrastructure. This unprecedented fact has entailed experimentation and continuous

learning in the whole stages of the placement process: capture (with a technique of "sliding loops" and handling them at sunset), harness design and assembly, and transmitter device selection. Each flamenco captured for the deployment was banded and registered its basic morphometric data. From the fifteen trackers mounted until now, only ten are in operation; the rest failed. Despite this, today we have registered sound evidence of the displacement of four individuals from Yucatan and Quintana Roo, towards the Island of Cuba even las Bahamas, covering in one-night, tracks of 500 km long. The next Figure (Figure 3) illustrates recent trajectories and location of these four flamingos (one of them, reaching Cuba switched off). The other six flamingos show constant mobility along the whole coast of the Yucatan Peninsula (see Figure 4).



Figure 3: Location of flamingos with the rings DNHZ, DNDX, DSVA, departing from the Yucatan Peninsula to Cuba and Las Bahamas. The “grey” tracker switched off after reaching Cuba Island.



Figure 4: Example of the DSFA flamingo movements at feeding sites in Ría Lagartos Biosphere Reserve, in salt evaporators of the Yucatán Salt Industry) during the months of December 2018 and January 2019.

By the end of this year, four more geo-trackers (made by the French Company “Xerius”) will be deployed to increase the number flamingos tracked. The geo-trackers databases have been integrated also into the GIS.

Banding juvenile flamingos

Since 2015 we have banded 1,977 young flamingos (PVC and metallic bands), increasing the amount of data that has been historically registered since 1999. Figure 5 shows a

picture of this important event. Currently we have collected any kind of banding existing databases, one significant source was the *National Bird Banding Laboratory* of the USGS, at US. We also recovered some data from the original manufacturer, Haggie Engraving Co, at US too. This led us to collect the most complete dataset about juvenile flamingos banded in Mexico. This database is being

prepared to be opened to the public at the end of this year comprising some different purposes: ecological scientific research, regional interactions between countries, supporting decision making and analysing along with other GIS data layers.



Figure 5: Banding juvenile Caribbean flamingos in August 2019. We marked 389 individuals in the Ría Lagartos protected area, in the middle of a severe drought.

By means of direct field observation, it has been possible to determine the mortality, movements and longevity of these birds through the reading of bands. In 2016, 297 banded birds were sighted in Ría Lagartos and Ría Celestún. Of these, we identified 29 individuals aged 18 (banded in 1999). The rest had been banded between 1999 and 2015 (López, 2017).

Educational and Social Program for the Conservation of the Flamingo

In the last five years, we have implemented an environmental education and community

development program in the four most relevant protected areas for the flamingo life cycles (Ría Lagartos, Ría Celestún, Los Petenes and Yum-Balam). These actions have continued the efforts to promote knowledge about the species and its habitat as well as raising social awareness, particularly among children, to create a culture of conservation and appropriate use of natural resources; these programs have targeted different social and economic sectors of the coastal villages immersed in the areas mentioned (see Figure 6).



Figure 6: Students from Miguel Hidalgo Y Costilla Secondary School, in El Cuyo Village, Yucatán, in 2019 during classroom educational activities on flamingos.

From 2015 to date, more than 5,000 students from different educational levels have received information on topics such as the biological cycles of the species, the ecosystems on which it depends, as well as issues of the regulations of the NPAs, water care, waste separation and responsible pet ownership, without neglecting training for the development of economic and recreational activities of local communities. As an essential part of the educational actions, didactic materials on the species have been generated for the dissemination of information. One of the greatest achievements of this effort is the

successful appropriation of an environmental culture linked to cultural aspects of the region, which is reflected in the appropriation of the flamingo as an emblematic species belonging to the communities. The training workshops that have had the greatest impact are those of bird watching for tourist activities in the localities. This has led many guides to provide reliable information to visitors attending the PNAs, thus contributing to the local economy. Another action of great impact has been the promotion of community murals where the flamingo is the main thematic axis, getting a sound population response (see Figure 7).



Figure 7: Collective mural painting created in El Cuyo, Tizimín, Yucatán.

Conclusions

In coordination with authorities, we have maintained the core actions of the flamingo conservation program. At the same time, over the last five years we have built up the bases for what will be the documentary, tabular and geographic information platform of the Caribbean flamingo in Mexico; this will be fully operational at the middle of coming year. Next year efforts will be directed towards the analysis of all the information gathered so far, in coordination with academic and with the assistance of the relevant government institutions.

As part of the process of consolidating the program, a monitoring system on habitat quality and food availability has been designed for the Caribbean flamingo. The baseline is expected to be established early next year in coordination with academic institutions in the Yucatan Peninsula. The need to integrate a regional network of flamingo observers is imperative; subsequent action in this regard will be given next year to better understand the Caribbean flamingo target population.

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