

1.-Exhaustive extractions of all nonnative species will be carried out in the La Zarcita springs area of the Zacapu Lake PNA, with the participation of the Fishermen's Union and local residents (five days per month, for 6 months).

Result: Exhaustive removal efforts targeting non-native species were conducted in the La Zarcita springs area. Although the original goal established an effort of five days per month over a six-month period, the target was fully exceeded, as removal activities were continuously implemented from January 2025 to January 2026, substantially extending the intervention period.

During this timeframe, five non-native species were recorded and a total of 6,537 individuals were removed, representing a cumulative biomass of 256 kg.

Fieldwork was carried out with the active participation of the Zacapu Regional Fishermen's Union and with operational support from staff of the Municipal Government of Zacapu, strengthening inter-institutional collaboration and fostering community involvement in local conservation actions.



Figure 1.- Fishermen in the extraction of non-native fish

2.-A desilting will be carried out in the area of La Zarcita springs. This activity will be carried out in the dry season so that there is less water flow at the site, with a frequency of three days per week, over two months.

Results

The project originally established that desilting activities would be conducted in the La Zarcita springs area during the dry season. However, this action has not yet been implemented,

despite substantial technical and administrative progress. The delay is primarily due to regulatory requirements and seasonal constraints rather than a lack of execution effort.

As an initial step, multiple coordination meetings were held with the State Secretariat of Environment of Michoacán (the state-level governmental authority responsible for environmental policy, conservation, and natural resource management in Michoacán) and the Municipal Government of Zacapu to present the project objectives and proposed restoration actions.

Because La Zarcita springs are located within a federally recognized Protected Natural Area (PNA), any physical intervention requires the involvement and authorization of several federal institutions. Consequently, coordination was expanded to include:

- CONAGUA (National Water Commission), the federal agency responsible for the management and regulation of national waters and hydrological infrastructure
- CONAPESCA (National Commission of Aquaculture and Fisheries), the authority overseeing fisheries resources and aquatic ecosystem use

Joint meetings with all relevant institutions determined that prior to any intervention within a water body inside a PNA, a technical baseline study was mandatory. Specifically, authorities requested:

1. A bathymetric study to characterize depth profiles and sediment accumulation patterns
2. A limnological assessment to describe the physicochemical and ecological conditions of the spring system

These studies were required to identify the exact source area of the spring, quantify sediment volumes, and ensure that sediment removal would not negatively affect hydrological dynamics or native biota.

To comply with these requirements, specialized academic collaborators with expertise in aquatic ecosystem assessment were engaged. Their participation allowed the successful completion of the requested technical studies, thereby fulfilling the main scientific prerequisite for regulatory authorization.

During subsequent field visits associated with these assessments, an additional environmental issue was detected: untreated domestic wastewater was entering the spring system through direct drainage inputs. This represented a significant water quality concern that needed to be addressed prior to any sediment removal intervention, as desilting under conditions of active wastewater inflow could exacerbate contamination and ecological stress.

However, by the time the studies were finalized and reviewed, the regional dry season had ended, and rainfall had already begun. Conducting desilting during the rainy season poses elevated risks, including increased turbidity, downstream sediment transport, and reduced operational safety. For these ecological and technical reasons, the intervention was responsibly postponed.

Coordination efforts are ongoing among the Municipal Government of Zacapu, the State Secretariat of Environment, CONAGUA, and CONAPESCA to secure formal approval for the intervention. This process involves official communications, technical documentation submissions, and inter-institutional review, all of which are mandatory when working within protected aquatic ecosystems in Mexico.

In parallel with regulatory procedures, logistical planning has been conducted. The springs are located in a confined urban setting, surrounded by walls, metal fencing, narrow streets, and nearby houses. These constraints prevent the entry of large dredging machinery. Therefore, the intervention strategy has been adapted to include:

- Manual sediment removal to minimize disturbance
- Use of small vacuum (vactor) units capable of operating within restricted-access areas
- Controlled sediment handling and disposal to prevent re-suspension or contamination

The Municipal Government of Zacapu is currently working on maintenance and improvements to the local sanitation network to prevent greywater discharges from reaching the La Zarcita springs. Addressing this source of pollution is now considered a necessary complementary step to ensure that future restoration actions produce lasting ecological benefits.

Although the desilting action has not yet been physically executed, all required technical, institutional, and logistical steps have been completed or are actively in progress. The delay reflects compliance with Mexico's environmental regulatory framework and seasonal ecological safeguards, rather than inaction. The project is now positioned to proceed as soon as final authorization is granted during the current dry season.



Figure 2.- Meeting with different institutions

3.- A repopulation of native species will be carried out in the La Zarcita springs area of the Lake Zacapu PNA. These activities will be undertaken for five days per month, over six months.

Results

The project originally proposed the repopulation of native fish species in the La Zarcita springs area of the Lake Zacapu Protected Natural Area. As part of an adaptive restoration strategy, a limited initial introduction of native species with higher ecological tolerance has already been carried out. However, the full repopulation program — particularly involving habitat-specialist and disturbance-sensitive taxa — remains contingent upon the prior completion of the planned desilting intervention and subsequent environmental stabilization.

Many of the native species targeted for later reintroduction in the Zacapu springs are characterized by high habitat specificity, low tolerance to turbidity, and strong sensitivity to physicochemical disturbance, particularly those associated with spring-fed, clear-water environments. Desilting operations — even when carefully managed — inevitably involve sediment resuspension, temporary increases in turbidity, localized reductions in dissolved oxygen, and physical substrate disturbance. Conducting large-scale repopulation of sensitive taxa before these disturbances occur would expose individuals to acute stress and likely result in high post-release mortality, negating conservation gains.

Accordingly, repopulation is being implemented in phases. The initial introduction of tolerant native species — supported by local fishers under technical guidance — serves as a transitional measure that allows partial recovery of ecological functions and occupation of niches vacated by removed non-native species while habitat conditions improve. The reintroduction of more sensitive native species will proceed in subsequent phases once hydrological and physicochemical monitoring indicate that the environment can sustain their long-term persistence. This phased strategy reduces ecological risk and increases the likelihood of successful population establishment and community recovery.

4.-Environmental education activities will focus on improving knowledge and the perception of native species conservation amongst the local population, in order to engage the community with the protection of the environment, by implementing a conservation curriculum in primary and secondary schools. This activity will take place during one week per month, over a whole year).

Results

Community outreach and awareness

During coordination meetings with the Municipal Government of Zacapu and the State Secretariat of Environment of Michoacán, environmental education was incorporated as a parallel and complementary component to field management actions. Because local residents observed the ongoing removal of fish from La Zarcita springs, targeted awareness campaigns were developed to explain:

- The ecological status of native and endemic species

- The impacts caused by non-native species
- The purpose and importance of removal efforts

Public talks and outreach conferences were delivered, with invitations extended to children and youth from local schools. These sessions emphasized the ecological value of native spring ecosystems and the conservation challenges posed by biological invasions.

Participatory diagnostic and social perception assessment

A participatory diagnostic workshop was conducted with local residents to evaluate the level of connection between the community and the spring ecosystem. Results revealed a significant disconnection from the site but also a strong interest among residents in becoming involved in conservation actions.

To better understand local perspectives, a series of social perception surveys was implemented. These surveys served a dual purpose:

1. To assess community awareness regarding invasive species and ecological problems
2. To inform residents about ongoing extraction and restoration actions

Survey results helped identify priority concerns within the community and guided the design of subsequent outreach and engagement strategies.

Institutional and youth engagement

A second participatory workshop was organized, this time including key governmental institutions identified as stakeholders. The State Secretariat of Environment of Michoacán provided technical guidance on workshop design to improve participation outcomes and strengthen collaboration between authorities and residents.

One of the most significant outcomes of this workshop was the engagement of a local high school. Follow-up meetings were held with the school principal, a biology teacher, and a group of academically outstanding students. Their interest led to the establishment of a youth participation program linked to the conservation project.

These students received training workshops covering:

- Identification of native and non-native fish species
- Basic fish biology, including sex differentiation and diagnostic traits
- Ecological problems affecting La Zarcita springs
- The risks associated with releasing non-native species into natural water bodies

The students have since taken an active role in outreach by producing short educational videos (“reels”) shared within their school and community to promote awareness of invasive species impacts.

They are currently organizing a science fair focused on local conservation, where they will lead workshops on the protection of native and endemic species from their community.

Integration into formal education

Due to the complexity of modifying official curricula in Mexico's public education system, it was not possible to introduce a new formal subject. Instead, teachers incorporated conservation topics into existing biology courses. Field-based open classes were conducted at La Zarcita springs, where students learned directly about local species and ecosystem issues.

Additionally, students formed a science group called "Ecomonitores Zacapu", which is currently receiving continued training and guidance as a youth environmental monitoring and outreach group. The group demonstrates strong motivation and is expected to remain an active partner in future conservation and monitoring activities.

Although the original plan envisioned a formal conservation curriculum, the project successfully adapted to institutional constraints and achieved broad educational and social engagement outcomes. Environmental education efforts have:

- Increased local awareness of native species conservation
- Improved understanding of invasive species impacts
- Fostered youth leadership in environmental stewardship
- Strengthened collaboration between community members, schools, and government institutions

This activity can therefore be considered successfully implemented through alternative, community-based educational pathways, with promising long-term benefits for conservation in La Zarcita springs.



Figure 3.- training workshops with students from the high school

5.-We will participate in updating the area's management plan, which has not been updated since 2005. We intend to take part in every relevant government meeting, for one year.

Results

All scientific information generated by the research team since 2019 — beginning with the first grant awarded by the Rufford Foundation and continuing through the current grant period — was compiled and formally shared with the lead coordinator responsible for drafting the updated management plan. These contributions include ecological assessments, invasive species data, native species conservation findings, and community engagement outcomes.

As a result of this collaborative process, a draft version of the updated management plan has now been completed. The project team has actively reviewed the document and provided technical input to strengthen sections related to:

- Native and endemic species conservation
- Invasive species management strategies
- Habitat restoration priorities
- Long-term ecological monitoring recommendations

The updated draft is scheduled to be submitted in February 2026 to the State Secretariat of Environment of Michoacán for formal review and administrative processing. Following this step, the document is expected to proceed toward official publication in the *Diario Oficial de la Federación* within the year.

The incorporation of multi-year scientific research into the official management framework represents a major conservation achievement. It ensures that restoration actions, species protection measures, and community-based strategies developed through this project will become part of the legally recognized planning instrument that guides decision-making within the protected area.

This outcome reflects several years of sustained collaborative work among researchers, local stakeholders, and government institutions, made possible in large part through international conservation funding support. Once published, the updated management plan will stand as a formal, long-term product of these combined efforts and will guide conservation actions in the Lake Zacapu PNA for years to come.



**PROGRAMA DE MANEJO DEL ÁREA NATURAL PROTEGIDA
“LAGUNA DE ZACAPU”**



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Figure 4.- Draft cover page of the Management Plan