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**CONSIDERATIONS AND OPPORTUNITIES TO STRENGTHEN THE IATTC'S
ACHOTINES LABORATORY**

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SUMMARY

Since its foundation in 1984, the IATTC’s Achotines Laboratory has promoted scientific research to support assessment and management of tropical tunas. This included various investigations on different areas of biology and ecology of tropical tunas, with the goal of gaining knowledge on the mechanistic processes that shape recruitment, population dynamics, and stock strength. The Early Life History Group has successfully led the work conducted at the Laboratory Achotines and developed a program that established it as a well-equipped and recognized multidisciplinary research facility, supporting studies on tuna biology and ecology, climate change, fisheries technology, bycatch reduction, husbandry technologies, among other areas ([Margulies et al. 2025](#)).

Research at the IATTC’s Achotines Laboratory has been at the forefront of early-life history studies on tropical tunas, with a particular focus on the yellowfin tuna, and has contributed substantially to the understanding of the biology of these species, especially during the pre-recruitment life stages. To date, the Achotines Laboratory represents the only institution worldwide to have successfully maintained a spawning population of yellowfin tuna in land-based tanks for nearly three decades. This capability

enabled research on spawning dynamics, genetics, and growth of adult fish, and the development of multiple studies with the early life history of the species (Margulies et al. 2001, 2007, 2016; Wexler et al. 2003). This work has been strengthened by long-standing collaborations with research institutions and universities worldwide, supporting capacity building, knowledge transfer, and sustained program development. A complete list of publications based on research at the Laboratory Achotines can be found on IATTC's [website](#).

Recognizing both the long-standing contributions of the Achotines Laboratory and evolving scientific opportunities relevant to the Commission, this document discusses considerations and potential areas of activity related to continuing strengthening research, collaboration, infrastructure, and scientific capacity at the Laboratory. These considerations are intended to support ongoing scientific activities aligned with the Antigua Convention and the scientific needs of the Commission, while recognizing operational and financial considerations relevant to future activities.

1. BACKGROUND AND FUTURE OPPORTUNITIES

The Antigua Convention states that the Commission shall perform the following functions, giving priority to tunas and tuna-like species:

Promote, carry out and coordinate scientific research concerning the abundance, biology and biometry in the Convention Area of fish stocks covered by this Convention and, as necessary, of associated or dependent species, and the effects of natural factors and human activities on the populations of these stocks and species.

Furthermore, the objective of the Antigua Convention is “to ensure the long-term conservation and sustainable use of fish stocks covered by this Convention, in accordance with the relevant rules of law”.

The Achotines Laboratory brings a valuable opportunity for the Commission in supporting the exercise of its functions and achievement of its goal. The Achotines Laboratory is a reliable, functional research center where the promotion, development, and coordination of scientific research under the Antigua Convention can be successfully achieved (see review of research at the Achotines Laboratory in Margulies et al. 2016; Margulies et al. 2024 and Margulies et al. 2025).

Building on the Achotines Laboratory's strong scientific and operational foundation, this document discusses considerations and opportunities for continuing to strengthen research, collaboration, and capacity-building activities at the Laboratory in support of the scientific needs of the Commission. These considerations aim to promote the continued development of the Laboratory's scientific capabilities while recognizing the importance of operational efficiency, collaboration, and external funding opportunities for supporting future activities.

2. KEY AREAS OF STRENGTHENING ACTIVITIES

The considerations presented in this document are organized into four main areas associated with opportunities to strengthen research, operational capability, capacity-building, and collaborative activities at the Achotines Laboratory (Figure 1). These areas are briefly described below:

2.1. INFRASTRUCTURE, OPERATIONS AND SCIENTIFIC CAPACITY

As a marine fish research science facility, located in an isolated area of the Republic of Panama, the Achotines Laboratory is a complex, multi-environment operation with specific infrastructure and maintenance needs (Scholey 1997). Continued efforts to maintain and strengthen the Laboratory's infrastructure, operations, and scientific capacity can support ongoing research activities and facilitate future scientific opportunities relevant to the Commission. Moreover, to ensure operational efficiency,

consistency, and scientific reliability, laboratory procedures and activities benefit from well-defined and standardized processes (Alvarez-Lajonchère & Cittolin 2013).

Areas of consideration include:

- a) Infrastructure and Facility Optimization
 - Assess and identify laboratory systems that need upgrade and improvements.
 - Modernize core equipment.
 - Strengthen/modernize physical structures of the Laboratory.
- b) Standardization and Process Formalization
 - Update, develop and implement Standard Operation Procedures (SOP) for all fronts of the Laboratory (administration, operation, scientific procedures, among others) in coordination with IATTC's headquarters.
- c) Key Certification Advancement
 - Evaluate certification pathways for the Laboratory.
- d) Technical Strengthening
 - Secure the ability to dispose of larvae and juveniles of yellowfin tuna, and potentially other species, for readiness research.
 - Focus on juvenile rearing and the potential of closing the life cycle of yellowfin tuna in captivity to consolidate the position of the Achotines Laboratory as a reference scientific institution of multiple capabilities. This will allow research with different life stages of the yellowfin tuna, a model species of tropical tunas (Margulies et al. 2025).

2.2. SCIENTIFIC RESEARCH ACTIVITIES

2.2.1. Key research activities

The Achotines Laboratory provides a unique opportunity to advance the IATTC's strategic science program ([SAC-16-07](#), Margulies et al. 2025). Research activities will be prioritized in areas directly supporting the Commission's mandate under the Antigua Convention, including, but not limited to:

a) Climate change

The IATTC has adopted a climate change workplan ([SAC-15-12](#)) to guide the development of climate-resilient fisheries in the eastern Pacific Ocean, emphasizing improved understanding of climate impacts, development of analytical tools, and their integration into management processes. Research conducted at the Achotines Laboratory directly supports these objectives, particularly in advancing knowledge of climate effects on early life stages of tropical tunas.

Experimental studies at Achotines have demonstrated that ocean acidification, warming, and other environmental stressors can negatively affect the survival, growth, and development of yellowfin tuna eggs and larvae (Wexler et al. 2011, 2023; Bromhead et al. 2015; Frommel et al. 2016). These results have provided critical empirical inputs for climate-informed modeling approaches evaluating recruitment, habitat suitability, and population dynamics.

A key outcome of this work has been its contribution and application to the spatial and ecosystem-based model SEAPODYM (Lehodey et al. 2008), in collaboration with the Pacific Community (SPC) (Nicol et al. 2022). This modeling framework represents a major strategic tool for the IATTC, enabling the integration of environmental variability and climate change into spatially explicit simulations of tuna population dynamics and habitat (Margulies et al. 2025).

Building on this foundation, continued research at Achotines can further support the IATTC climate change workplan by improving the parameterization of climate effects in stock assessment and ecosystem models, advancing understanding of species sensitivity and adaptive capacity, and strengthening the scientific basis for climate-informed management advice under the Antigua Convention.

b) Support of research focused on the development of new sustainable fisheries technology and by-catch reduction

The Achotines Laboratory can be continued used to support research on different types of fisheries technology, by-catch reduction devices, and biodegradable FADs. Moreover, the Laboratory Achotines has the capability to operate large tanks that can accommodate different species of interest to the Ecosystem and Bycatch Group and the Commission. The facility also includes a floating cage that supports a range of research activities, and benefits from the specialized staff with expertise in the capture and handling of live fish.

c) Research on pre-recruit mechanisms to improve our understanding of recruitment variability

Recruitment variability is one of the most important factors affecting tuna population fluctuations, and it is widely recognized as the largest source of uncertainty in fisheries population dynamics and stock projections used to inform management advice (Houde 1987, 1997; Subbey et al. 2014). Studying the biotic and abiotic factors that regulate recruitment can help reduce uncertainty in recruitment estimates. In recent years, advances in ecological modeling and the development of Management Procedure frameworks have created new opportunities to incorporate mechanistic biological knowledge into fisheries science. In this context, information generated from ecological and biological studies of pre-recruitment life stages can contribute to the development of recruitment forecasting tools that may ultimately support fisheries management decisions (Margulies et al. 2025).

Many of the mechanisms regulating recruitment, such as growth, survival, starvation, environmental variability, and density-dependent processes, have been extensively investigated at the Achotines Laboratory (Margulies et al. 2025), particularly during larval and early juvenile stages (Margulies et al. 2016). Building on this foundation, future research could further strengthen the link between early-life ecology and fisheries management in two key ways: information derived from early life history studies can be incorporated into ecosystem or environmental models to better understand how physical and biological processes influence recruitment variability; and expanding research beyond larval stages to include juvenile phases may provide additional insight into growth and survival processes occurring later in the pre-recruitment period, which can also influence year-class strength.

d) Genetic studies

Genetics studies conducted with adult fish in captivity can support research on reproductive biology and population dynamics (Niwa et al. 2003; Cusatti et al. 2022; Dimens et al. 2024) and may also contribute to the development of close-kin mark-recapture research (CKMR) applications. CKMR is a genetic mark-recapture approach in which population abundance can be estimated from the frequency of close relationships among sampled “re-captured” individuals (Bravington et al. 2016; [SAC-12-14](#)). Laboratory studies with adult fish provide controlled conditions where parentage and reproductive output are known, potentially allowing researchers to test and calibrate the genetic methods used to identify kin relationships in CKMR analyses.

e) Research on food security and aquaculture

As a laboratory focused on marine fish research, with a strong track record of studies across multiple life stages of yellowfin tuna, the Achotines Laboratory has contributed to the development of tuna

aquaculture techniques recognized by several institutions within the global aquaculture community (Margulies et al. 2016; Buchalla et al. 2024). Building on its technical expertise and infrastructure, the Laboratory offers opportunities to expand research on tropical tuna husbandry, supporting the sustainable use of marine resources and enhancing food security. These research efforts could be made accessible to CPCs, and opportunities for knowledge transfer could also be explored with interested stakeholders.

The staff will continue to identify other areas of interest that align with the Antigua Convention, are relevant to the Commission and can be supported by the Achotines Laboratory.

2.2.2. External collaborations and scientific integration

Building on a long and successful history of collaborations and partnerships, efforts will continue to identify and coordinate opportunities for joint research activities that strengthen scientific exchange, diversify research opportunities, and support areas of interest to the Commission. These efforts may involve collaboration with other tuna RFMOs, universities, research institutions, NGOs, and private sector organizations focused on the conservation and sustainable use of marine resources.

Research conducted at the Achotines Laboratory also provides opportunities to integrate knowledge across different areas of fisheries science, including biology, ecology, oceanography, ecosystem studies, and fisheries management, contributing to the scientific information available to the Commission.

2.3. SCIENTIFIC CAPACITY BUILDING AND KNOWLEDGE TRANSFER

The Achotines Laboratory has a long history of supporting scientific exchange, technical training, and collaboration with researchers, students, and institutions from different countries and scientific disciplines (e.g. aquaculture, biology and ecology, stock assessment, conservation of forest landscaping, among others). Continued efforts may further strengthen capacity-building and knowledge-transfer activities relevant to the Commission.

These activities may complement broader Commission initiatives related to capacity building under the Antigua Convention and Resolution [C-14-03](#), including technical training, scientific exchange, workshops, and collaboration with developing CPCs.

Areas of consideration include:

- Supporting technical workshops and training activities relevant to the Commission.
- Expanding scientific and technical exchange with universities, research institutions, and other collaborators.
- Supporting research training opportunities for students and early-career scientists.
- Continuing to align capacity-building activities with broader Commission initiatives and priorities.
- Identifying collaborative opportunities that may support scientific training and capacity-building activities.

These activities may contribute to strengthening scientific collaboration, technical exchange, and research capacity relevant to the work of the Commission.

2.4. COMMUNICATION AND OUTREACH

Continued communication of scientific activities conducted at the Achotines Laboratory may help strengthen collaboration, information exchange, and awareness of research relevant to the Commission. Outreach activities may also support engagement with scientists, collaborators, students, and other stakeholders interested in tropical tuna research and related scientific topics.

2.5. OPERATIONAL AND FUNDING CONSIDERATIONS

The Ashotines Laboratory currently operates through a combination of Commission resources, collaborative activities, and externally supported scientific initiatives. Existing resources support core operations, maintenance activities, and selected research efforts at the Laboratory.

Existing collaborations and partnerships have also supported scientific activities at the Ashotines Laboratory through externally funded research and joint initiatives. Continued efforts to maintain and expand these collaborations may provide additional opportunities to support research and capacity-building activities relevant to the Commission. Priority will continue to be given to activities that provide high scientific value while recognizing operational and financial considerations.

3. FIGURES

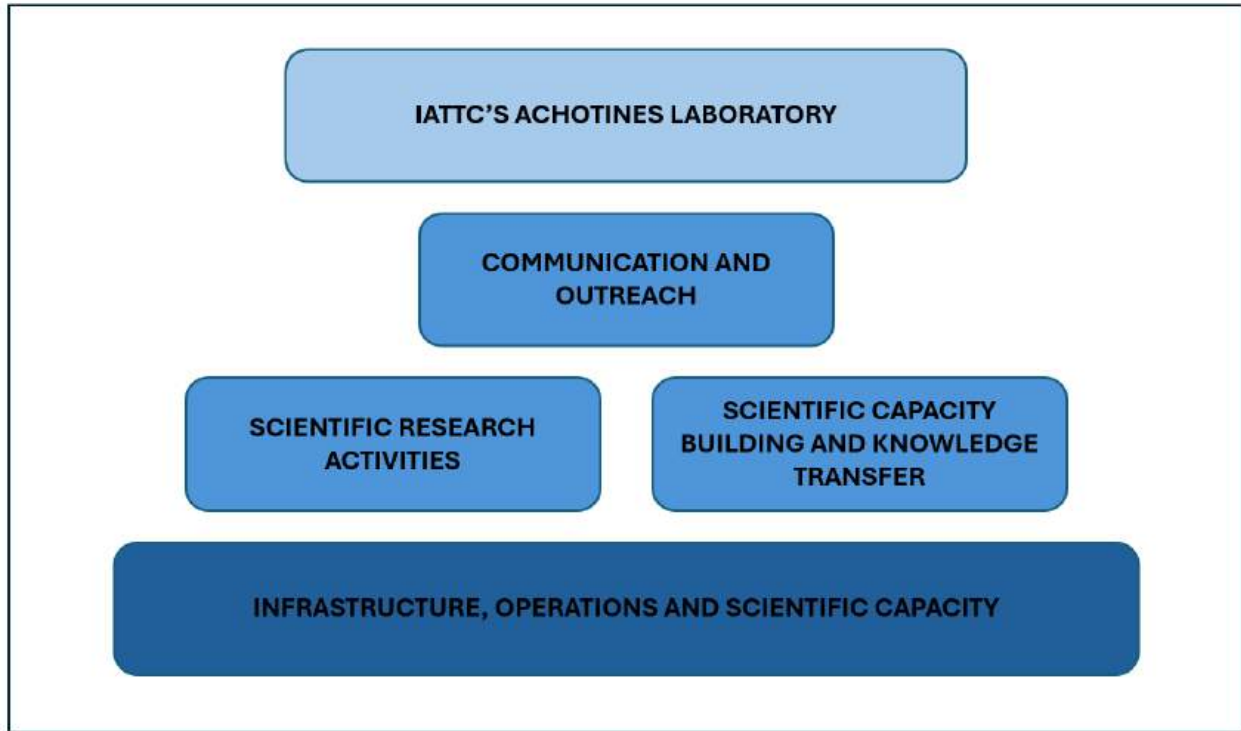


Figure 1. Main areas discussed for strengthening activities at the Achatines Laboratory.

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