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UPDATED BACKGROUND INFORMATION AND STAFF RECOMMENDATIONS FOR IATTC'S PROPOSED CLIMATE CHANGE WORKPLAN

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This document reports the staff's updated recommendations on climate change based on presentations and discussions at the IATTC's 1st Climate Change Workshop.

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SUMMARY

In 2023, the IATTC adopted Resolution C-23-10 on climate change. Since then, the IATTC staff developed a proposed climate change workplan (SAC-15-12) for the consideration of the Commission, which provided a general structure to promote climate-resilient tuna fisheries in the eastern Pacific Ocean (EPO), in the understanding that the details of the workplan and its implementation would be elaborated in consultation as appropriate with all relevant stakeholders. Additionally, draft Terms of Reference (ToRs) (IATTC-102 INF-B) were created for a series of climate change workshops meant to facilitate staff and relevant stakeholder discussions to begin to fill in the details of the workplan. The 1st climate change workshop was held over three days in February 2025, where participants were educated about the climate impacts on highly migratory species and tuna fisheries and discussed three key elements of the proposed workplan: main goal, scope, and framework. Each day focused on one of the key elements where an external speaker presented on their experiences in developing a climate change workplan for their organization. Then, IATTC staff presented preliminary recommendations for each key element, with the main goal and scope described in CC-01-01 and the framework outlined in CC-01-02. After presentations, the staff facilitated discussions about each element and the preliminary recommendations. This document provides an overview of the importance of each of these elements in climate-resilient fisheries workplans, a summary of the discussions at the workshop, and revised staff recommendations on the main goal, scope, and framework based on the feedback from workshop participants.

1. BACKGROUND

In recent decades, research has shown the direct and indirect impacts of climate change on marine species, ecosystems, and fishing communities. In recognition of these impacts on IATTC fisheries, and the conservation and sustainability of target and non-target species covered by the Antigua Convention, the IATTC adopted Resolution C-23-10 on climate change in 2023. The Resolution states that the Working Group on Ecosystem and Bycatch (EBWG), the Scientific Advisory Committee (SAC), and the Commission will include climate change as a recurrent agenda item at their respective annual meetings, and in general, "*highlight and consider the best scientific information available on the relationships between climate change, target stocks, non-target species, and species belonging to the same ecosystem or associated with the target stocks.*" As a result, the IATTC staff conducted a review of various climate-resilient fisheries tools, frameworks, roadmaps and workplans that various countries, organizations and international organizations have developed, in order to facilitate the development and adoption by IATTC, if the Commission so decides, of a workplan which would provide a general structure to promote climate-resilient tuna fisheries in the EPO (SAC-15-12), in the understanding that the details of the workplan and its implementation would be elaborated in consultation as appropriate with all relevant stakeholders. This approach was welcomed and supported during the 2nd Ecosystem and Bycatch Working Group, as well as by the 15th meeting of the Scientific Advisory Committee (see SAC-15 Recommendations). It was also briefly presented and discussed during the 102nd IATTC meeting in Panama in 2024.

This process, as proposed, anticipates five phases: 1) Planning, 2) Deciding on goal and scope, 3) Developing a framework, 4) Creating tools, and 5) Tool application and/or management implementation. Phase 1 may be considered as completed, following the review of climate tools and frameworks, along with other resources publicly available, as well as with the development of a proposed climate change workplan for the IATTC (SAC-15-12), and associated draft Terms of Reference (ToRs) for a series of climate change workshops. These draft ToRs (IATTC-102 INF-B) were also presented at the 102nd annual meeting of the Commission at its request. Although they were not formally endorsed then, they are similar to other ToRs used by similar processes of the Commission (e.g. EM workshop series) and there should not be any inconvenient in generally following the principles and guidelines that they contain, to the extent necessary, in order to start the proposed process of a series of workshops (see Table 1 in SAC-15-12 for a detail description of these workshops), without prejudice to their discussion and adoption by the Commission of a final version of the TORs that will be used for the remaining workshops.

Consistent with the discussion during the last meeting of the Commission, the process should continue in 2025 with the holding of a workshop on goal and scope (Phase 2; see document CC-01-01), but also on the development of a framework (Phase 3; see document CC-01-02). It is considered that these two phases, which both anticipate the provision of inputs and elements of discussion by Members and relevant stakeholders, can be considered in the same workshop. This workshop occurred on February 24-26, 2025 in a virtual setting, with workshop days lasting 3-4 hours.

The purpose of this document is to focus on Phases 2 and 3, and to describe the different elements and considerations that have been taken into account when developing and making recommendations on the main goal, scope, and framework of the proposed IATTC climate change workplan. This document also describes the topics and discussions that occurred at the 1st Climate Change Workshop. As such, this document contains a set of revised recommendations prepared by the IATTC staff that takes into account the discussions that occurred at the workshop. Appendix 1 contains the list of revised staff recommendations discussed so far.

2. MAIN GOAL

The objective of the Antigua Convention is *"to ensure the long-term conservation and sustainable use of the fish stocks covered by this Convention, in accordance with the relevant rules of international law."* The Convention reflects however the awareness of its negotiators that this long-term objective cannot be reached through a narrow focus on the targeted fish stocks only. In the end, the long-term health of these stocks and of the societies that depend upon them socioeconomically and for their food security is linked through a two-way relationship with the long-term health of other species, their habitats, ecosystems and the marine environment in general. Fishing of course may have its own impacts, but others, sometimes greater, can have their origin outside the fisheries activities. Among these, is climate change, because it threatens to produce a rapidly changing environment which could impact many of the functions of the Commission (Article VII of the Antigua Convention), including the following subparagraphs in paragraph (1); a, c, d, f, g, h, l, and v that directly focus on the science and management of target and non-target species conservation and sustainability. Therefore, to ensure short and long sustainability, fisheries scientists and managers across the globe are encouraging fisheries, which are made up of multiple entities, including fishing fleets, target species, non-target species, management measures, fishing communities, and seafood markets are climate resilient. Climate-resilient fisheries allow for climate change adaptation and mitigation within the fishery system while supporting healthy and productive resources and the communities that rely on them. Climate-resilient fisheries are expected to be flexible, dynamic, responsive, and anticipatory and take into account uncertainty as well as social and ecological interactions. In addition to being flexible, resilient fisheries should also be robust to change and be able to buffer climate impacts. With climate change potentially threatening and impacting the core objectives and functions of the Commission, it is critical to ensure that IATTC fisheries are climate resilient. It is also important to note, considerable resources have been invested globally over the last two decades in understanding the cause and effects of climate change on the physical and biogeochemical processes in the ocean. These data will constitute an important resource and basis to improve fishery science and management as the ocean changes.

The preliminary staff recommendation on the main goal, scope, and framework along with a summary on the workshop discussion, can be found in the report of the 1st Workshop on Climate Change. Based on the discussions with participants at the workshop, the IATTC staff revised the main goal of the climate change workplan recommendation to be:

> To ensure climate resiliency for fisheries and all species covered under the Antigua Convention, taking into consideration ecosystems and habitats they live in.

3. SCOPE

Scoping is one of the first stages that needs to be considered initially in the development of a workplan. This exercise should be approached and carried out with some degree of flexibility, especially in this specific context of the development of a climate change (i.e., climate resilient fisheries) workplan. The scoping questions below have often been considered in the development of

- What decisions are this climate change workplan intended to support?
- Who will be implementing the climate change workplan?
- What are the conservation and management targets (species, habitats, fisheries, communities) of the climate change workplan?
- What is the geographic scope of the climate change workplan?

- What is the temporal scope of the climate change workplan?
- Who are the key partners and stakeholders and how are they involved in the climate change workplan?
- What resources are available/needed for the climate change workplan, and how will they be covered?

3.1 What decisions are this climate change workplan intended to support?

Without ignoring the broader aspects and components of climate change and its challenges, since the plan is framed within the IATTC, it must be understood as primarily focused on supporting climate resilience in fisheries governed by the Antigua Convention, in particular, through the adoption of appropriate conservation and management measures. Secondly, the plan can also support decisions on how to best assess and account for the magnitude and impacts of climate change. For example, there are ways for stock assessments and management strategy evaluation to consider climate change.

The staff's revised recommendation is:

> The workplan is designed to support the development of science-based conservation and management measures that promote climate resiliency for fisheries and all species covered under the Antigua Convention, while also considering the ecosystems and habitats in which they live.

3.2 Who will be implementing the climate change workplan?

Development of the climate change workplan, but also its implementation, should take an "all-hands-on-deck" approach given the wide range of expertise needed to properly assess, adapt to and mitigate the effects of climate change. Based on the framework and tools selected, different phases of the plan may require implementation from various groups. The IATTC with the support of its scientific and policy staff and the input from relevant stakeholders, as appropriate, would contribute to promote and steer the process, among others through undertaking assessments of potential climate impacts and exploring, discussing, and recommending potential adaptation plans, whereas any management actions will need to be ultimately adopted and implemented by the Commission and CPCs.

Based on discussion at the workshop, the staff clarified its early preliminary recommendation and recommends:

> The workplan should be promoted and steered, and its implementation monitored, by the IATTC, with the support of its scientific and policy staff, the Ecosystem and Bycatch Working Group and the Scientific Advisory Committee.

3.3 What are the conservation and management targets of the climate change workplan?

Selection of the appropriate conservation and management target(s) is a critical step that varies across existing climate change workplans and one that needs to be decided on before moving forward, as it may have direct implications on the selected tools and availability of resources. Such targets may vary from specific species or habitats to various ecosystems, multiple fisheries, and dependent communities.

In the EPO, under the Antigua Convention the two largest categories of fishing gear are the industrial purse seine and longline fleets. Given the very high catches and the mobility of these two fleets and their target species and associated non-target species (i.e., highly migratory species), which often respond to environmental conditions, it is expected that both fisheries are expected to be impacted (directly and indirectly) by the effects of climate change. Further, smaller artisanal fleets that fish near the coast are

also expected to be impacted due to the same reasons described above and the potential effects on important coastal habitats (e.g., nursery grounds) to various species. Specifically, climate change may impact the sustainability and conservation of tuna and tuna-like species, on which both fisheries heavily rely, as well as of associated or dependent non-target species, ecosystems and habitats. An example of such impacts is the introduction by climate change of an additional stressor to bycatch species, whose effects and magnitude remain unknown. Therefore, it is important to understand the full range of potential climate change impacts, particularly on both target and non-target species and how it could influence their sustainability and conservation when it comes to the industrial purse seine and longline fisheries along with smaller coastal fisheries.

Given the discussions from the workshop, the staff's revised recommendation is:

> The highest priority conservation and management targets of the workplan should include tuna and tuna-like species and the fleets that target them, while also considering bycatch species, particularly vulnerable[1] ones, and all other species covered under the Antigua Convention that belong to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered under the Convention.

3.4 What is the geographic scope of the climate change workplan?

The geographic scope of the workplan as a whole comprises primarily the Antigua Convention area although specific components and actions may be more directly tied to specific areas used by the conservation target(s). In addition, it cannot be ignored that certain fleets and target and non-target species populations often move between the Western and Central Pacific Fisheries Commission (WCPFC) and the IATTC Convention Areas. Therefore, the workplan and its implementation and the tools that are required should take into account this multiplicity of geographic scales both within the Convention Area and beyond, as needed, while keeping in mind the limits attributed to major oceanographic features and management bodies.

Based on the discussions at the workshop, the staff's revised recommendation is:

> The primary geographic scope of the workplan should encompass the entire IATTC Convention Area while recognizing the importance of conducting scientific research across the broader Pacific Ocean basin. This includes collaboration with other RFMOs, their scientific bodies and service providers, as well as promoting appropriate coordination and cooperation with them.

3.5 What is the temporal scope of the climate change workplan?

The temporal scope of a climate workplan refers to the management timeframe of interest or concern. For example, are managers, fishers, and industry workers interested or concerned about what happens tomorrow, next week, next month, next year, or 10, 50 or 100 years from now? Different stakeholder groups may have different interests or concerns, and these may change depending on the time scale. Selecting specific or multiple time scales will directly influence research and the type of tools that can be used and how they are applied. Table 1 (taken from Holsman *et al*. (2019)), showcases the different time scales that could be considered, provides management examples that could be appropriate for each particular time scale, suggests the spatial scale that might be appropriate for that time scale, illustrates

[1] Unless specified otherwise, including but not limited to citations to vulnerability assessments and any qualitative/quantitative scores (e.g., BYC-10 INF-B; SAC-13-11; SAC-14-12), the staff's definition of "vulnerable species" refers to the species that, in the sensu latu, and due to their low-productive life-history traits (i.e. K species in r/K selection theory), are more vulnerable to the impacts of fisheries and other anthropogenic activities on these species or their habitat and ecosystem. This includes the marine mammals, seabirds, sea turtles and the elasmobranchs.

how often an update would need to be made, and provides examples of tools that would be appropriate for each time scale.

The time scales are usually broken up into three main categories as observed in Holsman *et al*. (2019): short-term (i.e., days, weeks, months), medium-term (i.e., 1-25 years), and long-term (i.e., 50-100 years). The IATTC staff notes that resources and stakeholders could benefit from considering management across multiple time scales. For example, a bycatch avoidance tool could be developed *daily*, *weekly, monthly*, or *seasonally* to help reduce bycatch interactions, whereas limits on fishing effort and catch, or biological reference points could vary *multi-annually*, and rebuilding plans for overfished stocks or protected species are often thought about in *decadal periods.* Finally, when considering the long-term health of these stocks and their associated ecosystems, including for instance decisions to build infrastructure (e.g., a fishing port) or invest in a future fishery, may require planning on multi-decadal periods, i.e., *50 to 100 years* in the future.

Given the workshop discussions the staff's revised recommendation is:

> The temporal scope of the workplan considers multiple time scales, ranging from short (up to one year) to medium term (one year to 10-25 years) to long term (25-100 years in the future), in a manner appropriate to its specific objectives identified for each of these time scales.

3.6 Who are the key partners and stakeholders and how are they involved in the workplan?

In many fisheries related climate change workplans and tools, success occurred when multiple types of partners/stakeholders/end-users, and thus multiple voices and perspectives, were involved (Carroll *et al.* 2023, MAFMC 2023) which ensured that a broad range of ideas, interests and priorities were taken into consideration during the process. On the contrary, there are also many examples of scientists or managers developing a specific tool without incorporating input from each other or other relevant stakeholders (e.g., industry), resulting in a product that is incomplete, misses some important aspects, challenges implementation, and does not ultimately help fully address the issue at hand. The IATTC manages an expansive geographical region which comprises a great diversity of species, ecosystems and fisheries. Because of this, it is considered more appropriate and efficient regarding many aspects and decision points of any climate change workplan to ensure a wide participation of experts and stakeholders through open-ended discussion-oriented workshops over the proposed timeline. As mentioned in the climate change workplan as proposed in document SAC-15-12, and the proposed workshop ToRs (IATTC-102 INF-B), this participatory approach will give a voice to these experts and relevant stakeholders throughout these workshops, along with the EBWG and the SAC, in the discussion and identification of, among others, the main goal and scope, a climate change framework, tool development, and potential management actions.

Changes reflecting the workshop discussion are in the staff's revised recommendation:

> The workplan and related activities should, as much as possible and where appropriate, be participatory and inclusive of all CPCs and other relevant stakeholders. This includes, but is not limited to, scientists, managers, fishers, industry members, RFMOs/RFBs, IGOs, NGOs, and subject matter experts.

3.7 What resources are available and how will they be covered?

The IATTC has some in-house resources available to provide relevant inputs in the development and implementation of a climate change workplan, including relevant expertise and several types of data, from fisheries to environmental. Since 2023, the time of one of its scientific staff has been partially dedicated to assessing short and long-term environmental effects on species and fisheries, including climate change

impacts, and developing mitigation options. Thanks to his extensive experience working on various climate and fisheries related tools, particularly those focused on highly migratory species, this staff member is expected to provide major inputs and support in the necessary work laid out in IATTC's proposed climate change proposed workplan (SAC-15-12), in addition to the contribution to be expected from the other members of the scientific and policy staff. Regarding the available in-house data, the IATTC has access to rich fisheries datasets, including, for example, Class-6 purse-seine observer program data with 100% coverage, and smaller observer data sets for Class 1-5 purse-seine and longline fleets. Other fisheries related data include those from logbooks, canneries, VMS, satellite-buoys associated to FADs, etc. (see SAC-11-11 for a complete description of the various fisheries-related data sources available at the IATTC). In addition, the IATTC also maintains a large tagging database that has been collected on tuna and tuna-like species intermittently over the last few decades. Its staff has recently developed an environmental database spanning the early 1990s to present, which has benefited indirectly from the extensive funding that has been dedicated globally, and at the regional and local levels, to studying and understanding climate and environmental impacts on the physical and biogeochemical processes in the ocean; the data acquired through such a collective effort will be most useful when combined, as it is intended, with the aforementioned fishery data.

As mentioned above, to move forward in the process embodied in the proposed workplan, it will require open discussions and discussing recommendations with the Commission workshops, research that requires specific equipment or development skills, or the development of specific communication tools that are difficult to anticipate at this very moment. The scoping decisions made by the Commission will be used to inform which tools will be necessary, how those tools will be developed, and the needed funds assessed and procured, including through grants that might become available as climate change impacts on fisheries gains more traction globally.

The staff took conversations at the workshop into consideration in the revised recommendation:

> The IATTC should ensure that the resources required for an appropriate development and implementation of the workplan are made available, including through extrabudgetary funding when available.

4. FRAMEWORK

After a thorough review and assessment of currently available climate-resilient fisheries frameworks (see Table 2), the IATTC scientific staff developed a proposed framework that incorporated many of the common features found in the four relevant examples described in CC-01-02. Those common features include stakeholder input, consideration of uncertainty, and examples of tools. Other features that were considered in the proposed framework that were common across most example frameworks were the inclusion of a goal and scope step, a cyclical and iterative structure, a climate vulnerability/risk assessment breakdown at multiple levels (e.g., species/stock(s), ecosystem, fishery, management), and at least one step where management actions could occur. All these common features received broad support from the members who attended this first climate change workshop on goal, scope, and framework. When designing an IATTC climate resilient fisheries framework, the staff preferred the simple structure of the Climate-Smart Conservation Cycle (Section 2.1 CC-01-02) because it provided an effective structural backbone to build the proposed IATTC framework from that will allow many of the details to be filled in during stakeholder workshops. For example, as a result of the 1st climate change workshop, input from participants suggested adding more detail on how the proposed framework is expected to be integrated into the current working structure of IATTC, particularly where and how the different steps of the framework would interact with the subsidiary bodies of the Commission (EBWG, SAC). For further descriptions of the workshop discussions on the steps of the framework and the common features see 1st Climate Change workshop report. The risk assessment levels, and associated tools described in the Climate

Adaptation Handbook (Section 2.4 CC-01-02), as well as in FISHE (Section 2.2 CC-01-02) and CAFF (Section 2.3 CC-01-02) were adapted and combined with the simple structure defined above so that each step considered the needs and management structure of IATTC. The proposed 7-step modified version of this framework can be found in Figure 1. Below is a description of each step that would be included in the framework, some potential tools and products that could be used to accomplish each step, and how each step may fit into the working structure of IATTC.

Step 1. Define goal and scope

Defining the goal and scope are usually the main elements of the initial step as established in many climate-resilient fisheries frameworks (Figure 1). The IATTC staff believes it is critical to have both defined before moving forward with the rest of the framework and workplan. The definition of the goal of IATTC climate change workplan will provide a baseline that can be reassessed later throughout the workplan (the iterative and cyclical nature of the framework, as needed, should be kept in mind). Addressing the question of scope leads to the definition of a number of key elements and topics to be defined, such as: what decisions the climate change workplan intends to support? Who will be implementing the workplan? What are the conservation targets (e.g., specific species or fisheries) of the workplan? What is the geographic extent (e.g., eastern Pacific Ocean, eastern Tropical Pacific) and temporal extent (e.g., one year, 10 years, 50 years, 100 years in the future) of the workplan? Who are the key partners and stakeholders involved, and what resources are available to accomplish the workplan? Each one of these questions and the main goal are described in detail in Section 3 which includes a series of recommendations from the scientific staff in their respect.

Due to the importance of defining the climate change workplan's main goal and scope before moving forward with the workplan, the staff recommended above that the Commission considers for adoption the proposed main goal and scope of the proposed climate change workplan described in Sections 2 and 3. To accomplish this task, the staff presented preliminary main goal and scope through a stakeholder workshop and subsequently made the necessary adjustments to the main goal and scoping based on stakeholder feedback. Through this document and a presentation, the staff will share these revised recommendations with the Ecosystem and Bycatch Working Group (EBWG), the Science Advisory Committee (SAC), and the annual meeting of the Commission for consideration and potential adoption.

Step 2. Assess climate impacts and vulnerabilities

This step is also common across all reviewed frameworks. To highlight the fact that climate change can impact many aspects of fishery management, the staff included a three-level assessment in Step 2 (Figure 1). Those three levels assess climate impact, vulnerabilities, risk, and barriers at the species and ecological level, fishery level, and management level. All of these are essential when understanding climate impacts and vulnerabilities at a fishery management organization. The three levels are represented in Step 2 in the proposed framework as a mini circle in which an assessment of each level is completed to fully understand climate impact, vulnerabilities, risk, and barriers.

There are many assessment tools that can be applied at each level, some of which are already being used at IATTC and others which will be determined at the later workshops.

Those workshops, which will offer the opportunity to specifically discuss strategic tools, will be tailored to the specific main goals, scope, and framework that will subsequently be considered for adoption by the Commission.

Although tools can be designed directly for the IATTC, many climate assessment tools already exist that can be adapted for the same purpose. For instance, assessment at the species and ecological level could be done through a species climate vulnerability assessment (Pecl et al. 2014, Hare et al. 2016, Boyce et al.

2024). A stock assessment that accounts for climate change or buffers for climate variability is another tool that could potentially be considered for assessments at the species level. Other species climate assessment tools that are already being developed at the IATTC include environmental databases, species distribution models, environmental and ecological indicators, and environmental physiological experiments on tuna larvae conducted at the Achotines Laboratory in Panama. Many of these tools can be developed for multiple priority species in the EPO and adjusted to incorporate climate change at various temporal scales.

A fishery climate vulnerability assessment could be done through the participation of fishery operators and industry stakeholders in various fishery adaptation surveys such as those developed in the Climate Adaptation Handbook (Fulton et al. 2020-Appendices E-H). Fortunately, the IATTC staff already facilitates discussions with fishers (e.g., captain workshops) to understand other aspects of the fishery. Incorporating various climate change scenario planning discussions and identifying where the fishery is vulnerable to climate change will provide a better understanding of ways to improve IATTC's climate resilience. A management climate vulnerability assessment could be conducted by fishery managers through scenario planning, qualitative modeling approaches, and surveys to identify which management instruments are most or least effective in adapting to mitigating climate related issues. Examples of management instruments that could be assessed for climate vulnerability at the IATTC are harvest strategies, best handling and release practices, dynamic ocean management, and gear limitations, among others. There may also be assessment tools where scientists, fishers, and managers need to come together to discuss climate risk at any or all of the three levels, especially when understanding the influence of one level on the other two levels.

A combination of tools may be required for a level (e.g., ecological level) to understand the full extent of the impacts and risk due to climate change. Thus, Step 2 will likely take longer than many other steps in the framework because this is the stage of the process in which much of the tools are designed and developed, and the bulk of the associated research is conducted. The results of each assessment tool will be described and written up in IATTC documents and/or peer-reviewed publications and would be presented to the workshops, the EBWG and the SAC to keep the members who are not involved in those tools development and implementation up to date. Additionally, this step could reoccur more than once whenever new data is available and climate impacts and priorities shift.

Step 3. Review goal and scope

Once the impacts and vulnerabilities are identified through the assessments in Step 2, it is important to review the main goal and scope of the workplan and to identify whether redefinition is needed in Step 3 (Figure 1). For example, if the assessment shows that the potential impacts caused by climate change are different than preliminarily expected, certain aspects of scope, like conservation targets or temporal extent, may need to be modified and adapted. The assessment may also lead to questioning or validating the relevance and feasibility of the previously discussed and considered main goal and scope. These types of discussions would occur in stakeholder workshops, that may lead to revised main goal and scoping recommendations that would eventually be shared through an IATTC document and presentation with the EBWG, the SAC, and the annual meeting of the Commission for consideration and potential adoption.

Step 4. Identify possible adaptation/management actions

In this step, the IATTC and its staff, along with relevant stakeholders, come together to develop and identify potential ways to reduce the climate change impacts and vulnerabilities identified in Step 2. During Step 4 (Figure 1) it is important to focus on adaptation strategies that address the greatest climate impacts and vulnerabilities. There should be a logical mechanistic link by which potential adaptation strategies reduce the vulnerabilities or enhance adaptive capacity (Stein et al. 2014). Adaptation strategies

can range from new management actions that will reduce climate related vulnerabilities to new science initiatives that may include innovative ways to more accurately measure the climate impacts on species, fisheries, and management. Usually, at this stage of the process, emphasis should be put on being innovative and creative generating a broad range of options and courses of action while avoiding constraining options to the limited set of conventional choices. There will be opportunities afterwards to evaluate the feasibility of these actions and consider other factors (e.g., time, funding) during Step 5. As an example, Stein et al. 2014 urges adaptation options that manages for both persistence and change because in the near-term, actions may be required to address urgent threats to maintain certain functions and elements. In the long-term, however, actions may require structural and transformative changes.

Exercises and tools to promote discussion among stakeholders have been developed and used to help identify possible adaptation/management actions. One general strategy Stein et al. 2014 suggest is to find ways to reduce non-climate stresses (e.g., releasing an animal back into the water), which when combined with climate change pose a greater threat to a species. Another general strategy is to protect or enhance features that improve adaptive capacity. For a species, protection of important ecosystem features or refugia as well as their habitat connectivity between key habitats may increase resilience and the capacity to shift distributions if needed. For a fishery, reducing specific regulatory barriers may allow fishers to more easily adjust to sudden shifts. Examples of potential adaptation/management actions or tactical tools include but are not limited to introducing or modifying harvest control rules, using climate informed reference points or triggers, creating or revising spatial and temporal management tools (e.g., closed areas, fishing seasons), using bycatch avoidance measures, changing fishing access rights, adjusting research prioritization, and modifying gear requirements. The type and feasibility of management action varies and is dependent on the management agency and associated laws. The identification and discussion of possible adaptation/management actions will occur in detail later in future workshops with participants and likely at the EBWG and SAC (tentatively planned from 2026-2028, see the workplan in SAC-15-12).

Step 5. Evaluate and select adaptation/management actions

Once an extensive list of possible adaptation/management actions has been identified (Step 4), during Step 5 (Figure 1), each should be discussed and evaluated to reduce that list down to the actions that should be effectively carried out. Priority should be given to actions that address both near- and long-term climate impacts and vulnerabilities and those that are robust to uncertainty. During the phase of evaluating, comparing, and weighing possible actions, it is important to take into account the effectiveness of each potential action on addressing the most critical impacts and vulnerabilities to meet the main goal. It is also necessary to consider how these possible actions may affect broader societal, cultural, and economic objectives. During this step it is also essential to evaluate factors that may enhance (i.e., opportunities) or prevent (i.e., barriers) successful adaptation or management action implementation, such as cost, CPC resources and capabilities, those of the IATTC and its Secretariat, and overall feasibility of the actions proposed. These types of criteria, as emphasized by Stein et al. 2014, should be clearly developed with metrics that measure how each action meets those criteria.

Similar to Steps 2 and 4, there are decision support tools that already exist that can help with this evaluation and selection. Management strategy evaluation is one tool where potential adaptation or management actions can be simulated and compared. Qualitative models and scenario planning exercises are other methods to evaluate each option. The evaluation could occur during a stakeholder workshop with the potential of conducting subsequent work outside of the workshop when more quantitative methods are used. The final evaluation and following management action recommendations will be described in an IATTC document and presented and discussed at the climate change workshops, the EBWG, the SAC, and the annual meeting of the Commission, as appropriate. It is important to note that this step along with many of the previous steps may occur multiple times as scientists increase their

understanding of climate vulnerabilities in the EPO, additional potential adaptation options become available, opinions around climate resilient fisheries change, and priorities shift. This is to say, adoption by the Commission of one management action in a specific year does not prevent the staff to recommend, or the Commission to adopt, later one or several management actions completing, substituting, or complimenting the previous one, if they are deemed to further improve climate resilience.

Step 6. Adopting priority adaptation/management actions

Step 6 (Figure 1) is not only the most important step but is likely the most difficult step to accomplish. There can be countless assessments and potential adaptation actions developed over the prior four steps (Steps 2-5), but their positive impact on fisheries management would be significantly reduced if adoption and implementation of those actions does not happen. The uptake of climate resilient fisheries into management has been usually slow for several reasons, including, the uncertainty and variability surrounding climate change impacts, resource availability, and difficulties, challenges, and lack of full commitment or understanding to manage fisheries differently than has traditionally been done under a more stable and less variable climate. Stein et al. 2014 discusses several factors that improve the chances of adaptation implementation, such as engaging with diverse stakeholders early on, plugging specific adaptation plans into the already existing management efforts, highlighting benefits across all sectors, demonstrating examples of success, and taking immediate action, while keeping your sights on larger change. It is to be expected that the process for the development, negotiation and adoption of any adaptation/management action and its subsequent implementation will have to follow the same process of decision-making set in the Antigua Convention, which means a decision of the Commission in its plenary. In addition to such action and to the process leading to its adoption and implementation, and prior to it (adoption may be anticipated to first occur in 2029), it is important to encourage the development of an adaptive mindset and framework that would prepare IATTC, its Members and relevant stakeholders for the impacts of climate change more quickly.

Step 7. Track and monitor action effectiveness

Given the ever-changing environment as a consequence of climate change, it is imperative to continuously monitor and track the effectiveness of any adaptation/management action across time and space. The consistent monitoring of the fisheries systems and other related ecosystem elements during Step 7 (Figure 1) would allow the Commission and its Members to adjust implementation of the plans, as necessary. It also ensures that the process of climate-resilient fisheries is iterative since the IATTC, as a regional fisheries management organization, will continue, through such monitoring, to witness and experience any change in the EPO fisheries. Monitoring post implementation of any management action highlights both the link between impacts and the implemented actions as well as the benefits and importance of their adaptive nature. Considering the criteria and metrics developed in Step 5 used to evaluate and compare adaptation/management actions will also be important when designing how to monitor effectiveness. Also, some of the tools used in Step 2 may be applied to track and monitor effectiveness of the actions and plans, such as, stock assessments, indicators, and fishery surveys. Although some stability is desired, when facing constant change it is crucial to have an opportunity to continuously revisit planning and the main goal and scope of the workplan, as these may need to change as climate change impacts the EPO and priorities shift. To this end, it is proposed that IATTC, through its staff, will work with various stakeholders to develop the necessary tools, track action effectiveness, and provide status updates through sharing and disseminating the relevant information and ensuring the appropriate follow-up within the climate change workshops, the EBWG and the SAC.

Based on the extensive review of available climate-resilient fisheries frameworks, considering how a climate resilient fisheries framework could be integrated with the structure of IATTC, and incorporating feedback from participants at the 1st climate change workshop, the IATTC staff recommends that:

The framework proposed in SAC-16 INF-P (Section 4 and Figure 1) is considered for adoption and, therefore, guide the IATTC climate change workplan.

5. TABLES

TABLE 1. Examples of the various management time scales and how climate-resiliency can be incorporated (taken from Holsman *et al*. (2019)).

TABLA 1. Ejemplos de las distintas escalas temporales de ordenación y cómo se puede incorporar la resiliencia climática (tomada de Holsman *et al.* (2019)).

Management measures	Example	Spatial scale	Frequency of update	"Climate-informed" methods
Short-term				
Rapid intervention	Harvest closures due to harmful algal blooms (HABs) and toxicological exposure	Subbasin	Daily	Risk assessment via climate nowcasts or forecasts; rapid response infrastructure; emergency funds.
Dynamic to seasonal measures	Bycatch reduction measures; endangered species protection; habitat impact reduction	Subbasin, subregional	Daily to annual	Predictive scenarios using projections of catch and bycatch.
Adaptive annual or biannual measures	Annual updates to harvest limits and targets; acceptable take limits	Basin, regional	Annual; biannual	Short-term projections to provide context for management decisions and/or environmentally based predictions of recruitment/ production (e.g. 1–2 years).
Medium-term				
Adaptive biological and ecological reference points	Climate- or multispecies based estimates of unfished biomass; annually varying natural mortality; aggregate maximum sustainable yield.	Basin, regional	1–10 years	Development of climate- and trophic-dependent BRPs based on mechanistic relationships among biological processes and environment.
Fishery stock management approaches	Rationalization programmes/catch-share programmes/essential fish habitat designations	Basin, regional	10–25 years	Projections of various alternative and *status quo* management measures under various climate and socioeconomic scenarios; climate and species projections for future stock share value.
Recovery and rebuilding plans	Overfished stock rebuilding plans; protected species recovery plans	Basin, regional	10–20 years	Projection of climate and environmental conditions; management scenario analyses evaluating species response to long-term climate drift and medium-term decadal variability in climate conditions.
Long-term				
Legislatively mandated conservation measures	Marine protected areas, critical species "take" protection; maximum groundfish harvest in the Eastern Bering Sea; eelgrass protection measures in Puget Sound.	Basin to regional	10–50 years depending on system and projected changes	Spatial analyses of climate-driven spatial shifts that may alter ecosystem productivity under future conditions.
Place-based conservation measures	Arctic commercial fishing moratorium area; California marine protected areas; Canadian marine parks.	Variable from subbasin to international.	10–50 years depending on system and projected changes	Projections of long-term changes in distribution; explorative evaluation of stock accessibility and productivity under future climate conditions.
International jurisdictions	International boundaries for harvest; international agreements for shared stocks	Regional, international	10–50 years depending on system and projected changes	Climate projection data to assess stock availability and access under future scenarios.

TABLE 2. The 13 features described for each of the four relevant climate-resilient fisheries frameworks. The features listed in the table are short for the following questions: 1) What is the intended use of the framework? 2) Where has this framework been applied? 3) Does it include a place where goal and scope are defined? 4) Is the framework cyclical and iterative? 5) Does it have any feedbacks in the cycle? 6) What is its periodicity (i.e., how often should the framework be re-run)? 7) Are examples of tools included? 8) Is a fillable workbook included? 9) Are there risk assessment levels and what are they? 10) Does the framework incorporate stakeholder input? 11) Does it discuss uncertainty? 12) Can the steps in the framework be adaptable? 13) Does at least one of the steps incorporate some type of management action/implementation?

TABLA 2. Las 13 características descritas para cada uno de los cuatro marcos pertinentes de pesquerías resilientes al clima. Las características enumeradas en la tabla son abreviaturas de las siguientes preguntas: 1) ¿Cuál es el uso previsto del marco? 2) ¿Dónde se ha aplicado este marco? 3) ¿Incluye alguna parte donde se definan el objetivo y el alcance? 4) ¿El marco es cíclico e iterativo? 5) ¿Tiene alguna retroalimentación en el ciclo? 6) ¿Cuál es su periodicidad (es decir, con qué frecuencia debe volver a ejecutarse el marco)? 7) ¿Se incluyen ejemplos de herramientas? 8) ¿Se incluye un manual rellenable? 9) ¿Existen niveles de evaluación de riesgos y cuáles son? 10) ¿El marco incorpora las aportaciones de las partes interesadas? 11) ¿Considera la incertidumbre? 12) ¿Pueden adaptarse los pasos del marco? 13) ¿Alguno de los pasos incorpora al menos algún tipo de medida/implementación de ordenación?

Features	Feature Description	Climate-Smart Conservation Cycle	FISHE	CAFF	Climate Adaptation Handbook
1) Intended use	The sector(s) the framework was intended for.	natural resource management	Fisheries	Fisheries	Fisheries
2) Application	Institutions or countries where the framework has been applied.	Modified for U.S. NOAA Fisheries	Cuba, Belize, Mexico	Supporting Fisheries and Oceans Canada	Australian Fisheries Management Authority
3) Goal and scope defined	Inclusion of defining goal and scope	yes	yes	no	yes
4) Cyclical/Iterative	Whether the framework is cycle and iterative	yes	yes	yes	no
5) Feedbacks in cycle	If feedbacks are described in framework	yes	no	no	no
6) Periodicity	How often the framework should be re-run	new data, modified goals, user-defined	new data	user-defined	new data, user-defined
7) Tool examples	Whether tools are provided at various steps	yes	yes	yes	yes
8) Fillable workbook	An available workbook that the user can fill out when undergoing framework	no	yes	no	yes
9) Risk assessment levels	Various risk assessments levels discussed in the framework	no	species/stock(s), ecosystem, fishery	species/stock(s), management, infrastructure	species/stock(s), fishery, management
10) Stakeholder input	The framework provides opportunities for stakeholder input	yes	yes	yes	yes
11) Discusses uncertainty	The framework discusses and/or considers uncertainty	yes	yes	yes	yes
12) Designed to be adapted	Can be adjusted/adapted based on user's need	yes	yes	yes	yes
13) Management action	Incorporates some form of management action/implementation	yes	yes	no	yes

6. FIGURES

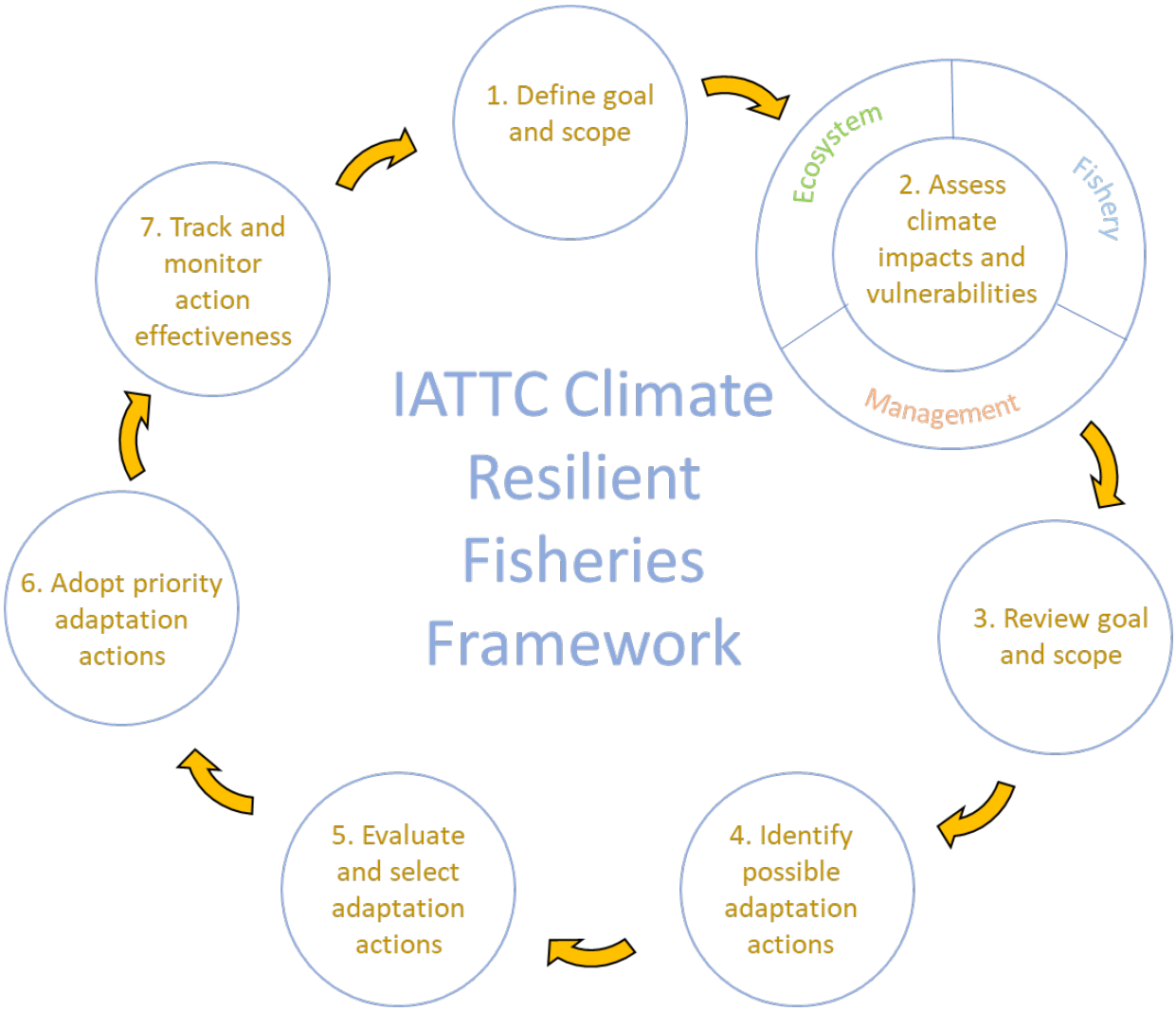

FIGURE 1. The proposed IATTC Climate Resilient Fisheries Framework, the structure for adaptation and fishery management implementation under a changing climate.
FIGURA 1. Propuesta de marco de pesquerías resilientes al clima de la CIAT, la estructura para la adaptación y la implementación de la ordenación pesquera ante un clima cambiante.

7. REFERENCES

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8. APPENDIX 1

List of staff recommendations of the proposed climate change workplan revised based on discussions at 1st Workshop on Climate Change. See workshop report for details on the discussions.

Main goal of the climate change workplan

To ensure climate resiliency for fisheries and all species covered under the Antigua Convention, taking into consideration ecosystems and habitats they live in.

Define the scope of the climate change workplan

1. What decisions are this climate change workplan intended to support?

The workplan is designed to support the development of science-based conservation and management measures that promote climate resiliency for fisheries and all species covered under the Antigua Convention, while also considering the ecosystems and habitats in which they live.

2. Who will be implementing the climate change workplan?

The workplan should be promoted and steered, and its implementation monitored, by the IATTC, with the support of its scientific and policy staff, the Ecosystem and Bycatch Working Group and the Science Advisory Committee.

3. What are the conservation and management targets of the climate change workplan?

The highest priority conservation and management targets of the workplan should include tuna and tuna-like species and the fleets that target them, while also considering bycatch species, particularly vulnerable[1] ones, and all other species covered under the Antigua Convention that belong to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered under the Convention.

4. What is the geographic scope of the climate change workplan?

The primary geographic scope of the workplan should encompass the entire IATTC Convention Area while recognizing the importance of conducting scientific research across the broader Pacific Ocean basin. This includes collaboration with other RFMOs, their scientific bodies and service providers, as well as promoting appropriate coordination and cooperation with them.

5. What is the temporal scope of the climate change workplan?

The temporal scope of the workplan considers multiple time scales, ranging from short (up to one year) to medium term (one year to 10-25 years) to long term (25-100 years in the future), in a manner appropriate to its specific objectives identified for each of these time scales.

6. Who are the key partners and stakeholders and how are they involved in the workplan?

The workplan and related activities should, as much as possible and where appropriate, be participatory and inclusive of all CPCs and other relevant stakeholders. This includes, but is not limited to, scientists, managers, fishers, industry members, RFMOs/RFBs, IGOs, NGOs, and subject matter experts.

7. What resources are available and how will they be covered?

The IATTC should ensure that the resources required for an appropriate development and implementation of the workplan are made available, including through extrabudgetary funding when available.

Climate resilient fisheries framework for the climate change workplan

The framework proposed in SAC-16 INF-P (Section 4 and Figure 1) is considered for adoption and, therefore, guide the IATTC climate change workplan.