INTER-AMERICAN TROPICAL TUNA COMMISSION

4TH TECHNICAL MEETING ON DORADO

San Jose, Costa Rica
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MEETING REPORT

REVIEW OF THE CONCEPTUAL MODEL AND AVAILABLE DATA FOR THE STOCK ASSESSMENT OF DORADO IN THE EASTERN PACIFIC OCEAN

Content

Executive Summary

Background: The Antigua Convention indicates that the Inter-American Tropical Tuna Commission (IATTC) should adopt, as necessary, conservation and management measures and recommendations for species belonging to the same ecosystem and that are affected by fishing for tunas in the Eastern Pacific Ocean (EPO), such as dorado/mahi-mahi (*Coryphaena hippurus*), which is vital for artisanal and recreational fisheries in the region.

Following the start of dorado research in 2012 and a first exploratory assessment of 2016 (SAC-07-06a(i)), the IATTC renewed its mandate in 2023 with Resolution C-23-09 for a new stock assessment and, in 2025, established the Working Group on Dorado with Resolution C-25-05. In this context, the 4th Technical Meeting was held in Costa Rica (DOR-04), whose central objectives were to update the conceptual model for dorado in the EPO, review data availability, establish a work plan for the next stock assessment, and discuss strategies to advance scientific research and monitoring for supporting fisheries management.

Current state of knowledge of dorado fisheries in the EPO: The meeting highlighted marked regional variability in data quality and monitoring systems. Peru and Ecuador maintain the most robust systems, with Peru leading global catches and Ecuador providing detailed biometric and effort data since 1989, although both face challenges in sampling the artisanal fleet. Other countries, such as Costa Rica, Panama, and Colombia, have made significant progress in implementing tracking systems (VMS), catch and effort reporting, and biological sampling, but still face limitations. Mexico and Chile report minor or seasonal fisheries.

Data: A considerable discrepancy was identified between the catch data held by the IATTC and alternative sources. Catch estimates based on alternative data (such as those collected by the FAO on catches, imports/exports) suggest that catch data should be reviewed.

Participating members committed to submit updated data on catch, size, CPUE, among others, for the assessment.

Participants identified five critical challenges for monitoring dorado in the EPO: financial and staff limitations, lack of harmonization in data collection methods, low coverage of onboard observers, resistance from the fishing sector, and difficulties in tracking the artisanal fleet. Despite these obstacles, key opportunities for improving information generation for management were highlighted, including regional collaboration and exchange of methodologies (e.g., binational projects between Peru and Ecuador), implementation of new technologies such as electronic logbooks and satellite monitoring systems (VMS), fostering public-private partnerships to finance data collection, and integrating fishers' empirical knowledge to improve the conceptual model and promote participation in decision-making.

Conceptual model and stock structure: An emerging consensus suggests that dorado in the EPO function as a dynamic meta-population, strongly influenced by ocean currents, sea surface temperature, and climate/oceanographic events (El Niño/La Niña). Preliminary genomic studies and tagging work indicate that, although regional differentiations exist, there is potential connectivity. Tagging studies revealed sex differences in behaviour: females tend to migrate against currents toward coastal and spawning areas, while males disperse faster with the currents. The discussions support the need for an assessment model that can consider both the hypothesis of stock separation and the north-south connectivity hypothesis, as well as the seasonal and interannual variability of the habitat.

Goals for dorado research and stock assessment: Participants discussed the desired goals for dorado research and stock assessment. The priorities are:

• Consolidate the conceptual model for the dorado stock in the EPO, incorporating different hypotheses on population structure and integrating oceanographic factors (temperature, salinity, currents, etc.).

• Investigate stock structure using genetic/genomic methods, tagging, and spatio-temporal models.

• Conduct a benchmark stock assessment considering two hypotheses for stock structure assumptions:

H1: Separate stocks

- One stock in Peru and Ecuador, as assumed in the 2016 stock assessment.
- Another stock comprised by areas off Central and North America

H2: Connected stocks: Extend the stock analysis limited to Peru and Ecuador to a larger area using available information for Central and North America.

Workplan for the stock assessment:

First semester of 2026: Submission of data (CPUE, sizes, catches) by CPCs.

Second semester of 2026: Progress report and pre-assessment workshop (preferably in September 2026, within the context of the Working Group on Dorado).

2027: Submission of the final assessment document during the SAC meeting in 2027.

Suggestions for the operation of the Working Group on Dorado: Participants discussed several aspects that could be useful for the functioning of the IATTC Working Group on Dorado (WGD):

- Appointment of two co-chairs for the WGD, one representing the south and the other representing the Central American and northern areas, given the heterogeneity of dorado population dynamics in the EPO.
- Continuation of the work initiated at DOR-04 within the framework of the WGD.
- Encouragement of regional collaboration through the exchange of methodologies and experiences.
- Strengthening of regional data collection programs, including tagging.
- Harmonization of the collection of biological and fishery data.
- Search for funding sources (including for human resources) to support the development of scientific knowledge, stock assessment, and monitoring of dorado.
- Inclusion in the agenda of the first WGD meeting a pre-assessment workshop when an account of progress on the stock assessment will be given.

1. Introduction

The Antigua Convention requires the Inter-American Tropical Tuna Commission (IATTC) to adopt, when necessary, conservation and management measures and recommendations for species that share the same ecosystem as exploited tunas in the Eastern Pacific Ocean (EPO). One of the species with high levels of interaction and incidental catch in the industrial tuna fishery is dorado (*Coryphaena hippurus*), also known in the EPO as perico, dorado, mahi, mahi-mahi, dolphinfish, and lampurga. Additionally, dorado is an important species in artisanal catches and is highly valued in recreational fishing by coastal nations in the EPO.

Research on dorado began at the IATTC in 2012. A series of regional workshops were organized by IATTC staff at the request of several EPO coastal Member States (DOR-01, DOR-02, DOR-03). These workshops fostered synergy among Member States to conduct dorado research, elaborate a conceptual model for the population, list available data, and, in 2016, reach an exploratory population assessment using integrated models (SAC-07-06a(i)), along with preliminary Management Strategy Evaluation (MSE) (SAC-07-06a(ii)). The 2016 dorado assessment focused on the area where most catches occur, in the southern EPO.

In 2021, Ecuador and Peru presented a joint research project (SAC-12 INF-D). Following its consideration, the Scientific Advisory Committee recommended the Commission to encourage the collaboration of CPCs participating, directly or indirectly, in dorado (SAC-12-REP).

Interest in conducting a second stock assessment of dorado in the EPO was renewed in 2023, when the Commission approved resolution C-23-09, *Research for Dorado Management*, which requires CPCs (Members and Cooperating Non-Members) to submit information on dorado and for the IATTC staff to conduct a new stock assessment. Similarly, in 2025, resolution C-25-05 created the Working Group on Dorado, which will begin operations in 2026.

The Republic of Costa Rica, in collaboration with IATTC staff and COREMAHI[1], organized and hosted the 4th Technical Meeting of the IATTC in the city of San José, Costa Rica. The meeting was chaired by Dr. Carolina Minte-Vera (IATTC) and coordinated by Ana Victoria Paniagua (COREMAHI). The objectives of that meeting were:

- Review the conceptual model for dorado in the EPO
- Review of the data needs to do a stock assessment
- Review of the available data and information
- Propose a work plan for updating the stock assessment
- Discuss needs to advance the Management Strategy Evaluation (MSE)
- Discuss a proposed workplan for the Working Group on Dorado

To achieve the objectives, participants were invited to submit presentations on the following topics:

- Population structure (genomics, genetics, conventional and archival tagging studies, other studies)
- Movement
- Age and growth, natural mortality, reproductive biology, sex ratio, recruitment
- Fleet structure (fleet characteristics, areas and periods of operation, industrial, artisanal, and sport fishing)

[1] Committee of Producers and Processors of Mahi https://www.coremahi.org

- Fishery statistics (catch, discards, effort, size composition, observer at-sea data, port data)
- Description of fishery monitoring and control systems, description of sampling systems for scientific purposes and fishery data management
- Review of data collection forms for dorado

The background presentation (DOR-04-PRES-01) was presented by Dr. Carolina Minte-Vera. This presentation established the context of the 4th Technical Meeting on Dorado, reviewing the history of IATTC work on dorado since 2014 and the conceptual model for the stock used in the last assessment.

This document describes the work, discussions, and knowledge generated during the meeting (Agenda, appendix 1).

The meeting focused on three aspects:
1) Update on fishery knowledge and conceptual model for stock, including discussion of challenges and opportunities for monitoring dorado in the EPO;
2) Discussion of the work plan for the next assessment;
3) Discussion of recommendations for dorado research.

2. Update on fisheries knowledge.

Presentations updated knowledge on dorado fisheries and biology in the EPO (Appendix 1), and focused on each CPC:

Peru

Dr. **Sandra Cahuín Villanueva** (DOR-04-PRES-02) described the adaptive monitoring system implemented by IMARPE for the perico/dorado fishery in Peru, combining data collection on land (ports), at sea (observers), satellite tracking (SISESAT), and fishing logbooks. The system, progressively developed since the 90's, uses biological and fishery data to support management measures such as temporal closures (fishing is allowed from October 1 to April 30 of the following year[2]), minimum size limits (70 cm), and national action plans.

Discussion:

It was noted that fishing closures are established based on both the recruitment and reproductive periods of dorado, with fishing being suspended as a precautionary measure between May and September. Furthermore, the fishery is managed through a seasonal quota system, corresponding to the maximum allowable catch limit, set for the current 2025–2026 season at 64,000 tons. Participants discussed the quality and coverage of available information, confirming that Peru maintains detailed monthly and biometric records, including sex information. However, challenges persist regarding the obtaining georeferenced data from the artisanal fleet and biological data, as the processed fish is rarely landed whole.

It was also clarified that approximately 90% of the Peruvian artisanal fleet uses gillnets or longlines as the primary fishing gear and, unlike Ecuador, there is no commercial mothership fleet ("nodriza"). Vessels record fishery information in their fishing logbooks, and have no georeferencing monitoring system. Finally, it was specified that the quota system is differentiated based on capacity ranges, for vessels smaller and larger than 20 cubic meters; however, the fishery and biological collection data is the same regardless

[2] R.M. No. 245-2014-PRODUCE establishes a fishing closure on the perico/dorado fisheries from May 1 to September 30 each year; therefore, fishing is allowed from October 1 to April 30 of the following year.

of vessel capacity. It was also indicated that the quota allocated for the previous season (2024-2025) was not reached.

Ecuador:

Esteban Elías (IPIAP, Ecuador) presented "Monitoring of the Dorado/Perico Fishery in Ecuador" (DOR-04-PRES-03), which is the IPIAP program for monitoring landings of the large pelagic artisanal fishery, focused on estimating spatial and temporal variability of dorado catches and determining growth parameters. Data collection mechanisms, binational collaboration with Peru to harmonize methodologies, and tagging projects, genomic, and reproductive studies were detailed. This information is vital for National and Regional Plans, enabling evidence-based management and active participation of fishermen through public-private alliances.

Victor Cevallos (Undersecretariat of Fishery Resources, Ecuador) presented "Biological Data of the Dorado Resource Reported in Ecuador during the Period 2019-2025" (DOR-04-PRES-04). Biological and catch data collected by observers on board the longline dorado fishery in Ecuador between 2019 and 2025 were analyzed. Dorado constitutes 87.61% of the catch in the directed fishery ("fino") and 13.51% in the incidental fishery ("grueso"). The size structure shows a consistent mode of 70 cm fork length for both sexes, and most individuals are mature. In 2022, females predominated; in 2023-2025, the sex ratio was more balanced. These data strengthen fishery knowledge and are fundamental for the regional stock assessment led by the IATTC. It was recommended to harmonize the monitoring systems between the CPCs.

Discussion

For the first assessment, the index of abundance for dorado was based on Ecuador's data because they had good catch per unit effort data, details on hook type, etc., and coverage was satisfactory. Are those data still being collected? Large sampling effort was conducted 10 years ago along the coast. Currently, the coverage is similar and information, by boat and by port, and details of the gear are still taken (classified by hook types, “fino” and “grueso”, “fino” are hooks number four or five, used for dorado, and “grueso” which is number 37 or monell, for other species). The sampling effort is lower due to financial and technical constraints. The sampling went from two seven-day monthly trips to one five-day trip and the number of ports visited decreased. Unlike Peru, sampling is allowed during the closure period in Ecuador, as it is permitted to bring dorado in small quantities and over 80 cm total length. There are data since 1989, when the fishery began in Ecuador. There are over 100 fishing ports along the continental coast, but the most important were initially 10 ports, then 8.

Currently, there no longer data collection in Esmeraldas Port or is there no fishing? IPIAP does not collect information in Esmeraldas Port due to lack of funding, but fishing activity continues. The Secretariat collects information through inspectors. The IATTC, with shark landing monitoring, has staff in Esmeraldas and is collecting dorado landing data, weight, and number of individuals.

Costa Rica:

José Miguel Carvajal, Alexander Salas Jiménez, and **Nixon Lara-Quesada** presented the work of INCOPESCA (DOR-04-PRES-05) on the dorado fishery in the Costa Rican fleet. Costa Rica's approach to marine management was detailed, characterizing the longline fleet and describing its data collection and monitoring systems. Costa Rica has a medium-scale advanced longline fleet, in addition to a sport and tourist rod-and-reel fleet (~455 vessels) practicing catch and release. The longline fleet operates primarily in high seas, outside the EEZ. The monitoring and data collection systems consist of: 1) mandatory VMS (Vessel Monitoring System), used to track vessel locations and enforce fishing zones; 2) Logbooks, implemented in 2017, which are filled by captains and provide detailed per set operational data and

transshipment information; 3) Biological sampling initiated in 2015, conducted at landings to obtain size, sex, and biometric data; 4) Inspection: an in-port inspection program has evolved since 1990 to 100% inspection in certain periods; 5) Electronic monitoring: a pilot plan combining human observers and electronic technology (EDGE cameras, electronic logbooks) is being implemented to improve coverage and report incidental catches (sharks, turtles, rays); during March to September 2025, observer coverage was 6.1% (105 effective fishing days). The only conservation measure implemented for dorado in Costa Rica is a minimum landing size (LTMC) of 80 cm (Resolution AJDIP/026-2018). Continuous capacity building for both the fishing sector and government was emphasized, as well as collaboration with IATTC working groups for developing protocols for handling and release vulnerable species.

Discussion

The discussion focused on standardizing biological measurements of dorado in the Eastern Pacific, especially regarding minimum landing size. It was clarified that in Ecuador, official regulations establish a minimum size of 80 cm total length, while various research institutes and other countries in the region use fork length because it provides more consistent and comparable measurements. Participants noted significant differences between total length and fork length, particularly due to variability in caudal fin size, which can generate inconsistencies between countries and projects. Therefore, it was proposed to promote regulatory changes and advance towards a regional standardized methodology based preferentially on fork length. The need to develop mathematical relationships between both types of measures, and also between total weight and gutted weight, was also highlighted to facilitate historical and regional comparisons.

Regarding Costa Rica's fishery, it was explained that it is not exclusively directed at dorado (representing only 20% of catches), but is carried out with surface gears that vary by season: during dorado season, monofilament lines and circle hooks (sizes 13-15) are used, while the rest of the year lines are lowered to 40-50 m depth. The use of circle hooks and monofilament was highlighted as significantly reducing incidental turtle catch compared to polypropylene.

Finally, the viability of conducting a joint stock assessment for the Central-North region was discussed. It was noted that although catch volumes in Central America are lower than in Peru or Ecuador, new tools (satellite tracking, port sampling, tagging, genetic studies) allow advancing towards a unified conceptual model. However, the high interannual variability in catches may be driven by regional fluctuations in resource availability, which limits the interpretation of peaks and declines in CPUE as indicators of changes in stock biomass.

Colombia:

Luis Zapata and **Emiliano Zambrano Rodriguez** presented "The Dorado Fishery in the Colombian Pacific" (DOR-04-PRES-06). The dorado fishery in the Colombian Pacific operates mainly between December to April with a mixed fleet (“pesca blanca” and shrimp trawlers adapted with longlines). Despite a historical reduction in fishing effort (reduction in number of sets from nearly 2,000 in 2003 to 500 in 2022), an average catch of 540 tons/year is maintained. The average size in 1995-1996 was 127 cm and most individuals were larger than 90 cm. For the 2023-2025 seasons, sizes remained at similar values. The highest proportion of females is found in sizes below 130 cm. Recent biological data (2023-2025) were obtained through at-sea observers and port sampling.

Discussion

Where are the small dorados in Colombia? There are none. The largest individuals are in the north. In Colombia, the fishery is very seasonal, with individuals in very advanced gonadal stages and then presence of larvae. At the beginning of the year, the trade winds from the north reverse the Colombia Current (which

is a branch of the Humboldt Current) allowing a small upwelling, which brings large pelagics (even whale shark, billfish), all in reproductive activity. There has been a national discussion about limiting dorado fishing considering that they are in the reproductive process. However, this resource is an alternative for shrimp fishermen, which is the main fishery and is closed during this period of current inversion. This must be considered when the regulations are made. During the La Niña period, dorado do not enter the Colombian EEZ.

Is only Buenaventura Port monitored? Almost all the landings concentrate on Buenaventura Port, due to access to roads and facilities (i.e. ice) in this port, not available in other places. There are also incipient landings in Tumaco, fisheries that go to Colombia and Tumaco fishing banks.

Panama

Robert Duarte presented on the dorado longline fishery in Panama (DOR-04-07). The presentation focused on the analysis of biological and fishery data from the longline fleet (small, medium, and large scale) within Panama's Exclusive Economic Zone (EEZ), with samples collected in the ports of Panama, Remedios, Mutis, Mensabé, and Vacamonte. Panama has 484 active longline vessels (275 small scale, 121 medium, 88 large scale). In 2025, only 12% of vessels were dedicated exclusively to dorado due to fleet relocation towards tuna fishing. Catches from 2017 to 2025 varied from 200 tons in 2025 to 1,400 tons in 2023. Monthly landings indicate two fishing seasons, one between October and February and another between May and August. During the biological sampling in 2024-2025, 3,648 individuals were measured, of which 99.6% exceeded the size of first sexual maturity (55.8 cm), confirming that the fleet catches mainly adults. The sex ratio is skewed towards males (59%). Commercial sizes for export are above 80 cm. Males peak sizes were between 93 and 141 cm and females between 90 and 123 cm. The average annual size varied, with July being the month with the lowest average size (102.45 cm). The analysis of gonadal stages in 44 females indicated that reproduction likely occurs year-round, with stage IV (pre-spawning) being the most frequent (43%). The Panamanian authority (ARAP) considers that current data justify eliminating the current closure, given that catches are of mature adults. A complete year of gonadal stage data (until July 2026) is required to support any new management proposal. It is suggested to establish a national continuous sampling program and improve collaboration with the fishing sector to ensure the contribution of biological samples (especially females) during landings.

Yesuri B. Pino presented "Fishing in International Waters: Focus on Dorado Fishing by Panamanian Vessels" (DOR-04-08). Operations of the Panamanian international service longline fleet (class 6 purse seiners, international service longline vessels >20 m LOA) capturing dorado as a secondary species in waters outside the EEZ and third countries between 2021 and 2024 were detailed. A robust monitoring and control system is described, including mandatory satellite monitoring (VMS), 100% at-sea observers (purse seiners), and exclusive landing in authorized ports, integrating data into E-LAND and E-CATCH systems to ensure traceability and generate reliable fishery statistics through cross-referencing logbooks, landing reports, and observer data.

Discussion

Gonadal stages V and VI are spawning and regression; what is the criterion for stage VII? A guide with VII stages has been used, with VII being regression as well, but it needs to be refined with microscopic study. Regionally, there is no consensus on a validated maturity scale. A harmonized scale reading should be developed and there is effort in Peru and Ecuador to do so.

Progress in data collection in countries outside Ecuador and Peru is very important to reinforce understanding of where the largest catches occur.

May, June, and August have a peak in catches Panama, but in other regions they decline. An explanation may be related to the local oceanographic conditions. There are two Gulfs, Chiriquí and Panama, one with marked upwelling and the other not. The change in upwelling due to lack of winds in 2025 corresponded to the lack of dorado in the Gulf of Panama.

Mexico:

Dr. Sofía Ortega-García presented "Indirect Indicators of the Dorado Population Status in Baja California Sur" (DOR-04-13), based on monthly biological sampling of the sport fishing fleet in Los Cabos (2002-2025), where dorado represents 35% of the catch. Mexican regulation (NOM-017-PESC-1994, DOF, 1995), which regulates sport-recreational fishing activities in federal jurisdiction waters, indicates that dorado is a species reserved for sport fishing, within a 50 nautical mile from the coast. Within the Major Pelagics Project (INP-CICIMAR), sampling is done three days per month. Indicators such as size structure, condition factor, and gonadosomatic index were analyzed. The average size has remained stable (~89 cm males, ~82 cm females) with marked seasonality associated with warm temperatures (Northern Hemisphere summer-autumn, August to November), coinciding with the highest reproductive activity. Above 95 cm size, there is a higher proportion of males than females. Indicators suggest that the population in the region maintains healthy body and reproductive condition despite high interannual variability.

Discussion:

A question about the continuation of the growth studies carried out by Dr. Ortega-Garcia was done and whether there are comparisons in growth between various regions in the EPO. Comparisons indicate that growth in Mexico and Central America is similar. Comparisons with Peru it was not possible to make yet because different techniques are used.

Chile:

Dr. Patricio Barría and Andrés González (*Instituto de Fomento Pesquero*, Chile) could not attend the meeting but sent a contribution available on the workshop page: "Diagnosis of the Dorado Fishery in Chile, Period 2005-2025" (DOR-04-14). The artisanal dorado fishery in northern Chile, located at the southern limit of the species' distribution, was analyzed. Landings are seasonal (mainly austral summer) and highly variable, representing a lower volume compared to other species such as swordfish. However, biological indicators (sizes >60 cm, 99.5% mature) and rapid recovery of relative abundance in recent seasons suggest that the spawning stock is not overfished, showing good resilience at the extreme of its distribution range.

Central America and coastal fisheries:

Ernesto Godelman contributed a recorded presentation "Considerations on the dorado (*Coryphaena hippurus*) fishery in Central America" (DOR-04-11). A historical reconstruction of landings (2000-2024) was presented for Panama, Costa Rica, Nicaragua, and Guatemala, using USA import data as a proxy due to the lack of reliable local statistics. The analysis reveals a strong correlation between landings and the Southern Oscillation Index (SOI), suggesting that resource availability depends on environmental variability (migration during El Niño/La Niña events) rather than changes in stock abundance. Although size structure indicates that spawning areas are avoided, the authors conclude that the current risk analysis (ERAEF-RBF) is insufficient to declare the fishery low risk, requiring quantitative stock assessments at the regional scale.

Salvador Siu presented "Studies of Coastal Fisheries in the IATTC: Summary of work on ABNJ-1 and ABNJ-2 projects" (DOR-04-12). Projects ABNJ-1 and ABNJ-2 aim to improve data collection in coastal fisheries for sharks (and associated species like dorado) in the EPO. After lessons learned in Central America (ABNJ-1), the sampling program was expanded to Ecuador, Mexico, and Peru (ABNJ-2), implementing standardized sampling designs for artisanal and industrial fleets. The long-term objective is to generate consistent data series (catch, effort, biology, tissues) allowing conventional stock assessments and CKMR

analyses, especially for silky shark, finally integrating these coastal fisheries into IATTC regional management.

Discussion:
The importance of this type of regional program to improve information was highlighted. Over 10 years, all shark landing sites were mapped and sampled. Could that information be used to delineate sampling for dorado? Yes, because the study was directed at large pelagics. The cost for that has been obtained for Central America, but when ABNJ2 ends, a cost estimate for the entire area could be made. Costs for monitoring sharks may differ from costs for monitoring dorado, but there is information from the projects to make an estimate.

2.1 Challenges and Opportunities for Monitoring Dorado Fisheries in the EPO

Participants discussed challenges and opportunities for monitoring dorado fisheries in the EPO. Five challenges affecting almost all EPO countries:

1. **Financial and staff limitations**: Lack of budget and qualified technical personnel to cover ports and process information.
2. **Data collection harmonization**: Methodological differences in how the data is measured and recorded, hindering the creation of a coherent regional database.
3. **Low observer coverage:** Difficulty in getting personnel on board, either due to lack of space on small boats or lack of resources.
4. **Sector resistance**: Distrust or lack of awareness among fishermen regarding the importance of providing accurate data.
5. **Data gaps in the small-scale fleets:** Technical difficulty in monitoring and geolocating the activity of artisanal or small-scale fleets.

However, there are common opportunities that can be used to improve data collection to inform resource management:

1. **Regional collaboration:** There is consensus on the need for a shared database, and there are successful experiences of methodology exchange and joint research, such as the binational collaboration between Ecuador and Peru, and the regional data collection project for artisanal fisheries (IATTC ABNJ 1 and 2 projects).
2. **Applied technology:** Great potential to implement electronic logbooks, VMS in small fleets, and electronic monitoring tools.
3. **Public-private alliances:** Motivation derived from the willingness of fisheries to seek sustainability certifications. Opportunity to involve NGOs, industry, and tourism sector (especially in Central America) through Fisheries Improvement Projects to finance and improve data collection.
4. **Fishermen's knowledge:** Recognition that integrating the empirical experience of crew members improves data precision and facilitates participative decision-making.

Each CPC also has specific challenges and opportunities (Table 1).

Table 1. Challenges and opportunities in each CPC regarding monitoring and data acquisition of dorado in the EPO.

CPC	Challenges	Opportunities
Peru	• Logistics and funding to obtain representative samples • Lack of complete fishing effort coverage • Need for improvement fishermen awareness • Low at-sea observer coverage	• Strategic alliances with fishermen to improve data collection • Use of ancestral knowledge for historical series • Leadership in regional standardization of biometric and biological sampling
Ecuador	• Need for qualified personnel for rapid data processing • Increase observer coverage (goal of 20%) • Need to train and raise awareness among parts of the fishing sector about the importance of providing information	• Possesses a successful landing monitoring system (80-90% coverage) • Has human observer program on motherships [*nodrizas*] (10% coverage) • Has robust and consolidated databases. • Support from NGOs and industry through Fisheries Improvement Projects (FIPs).
Colombia	• Achieve industry commitment in data provision • Need to synchronize national budget allocation with dorado fishing seasons to ensure sampling.	• Concentration of fishing activity in only two main ports • Presence of large dorado allowing for reproduction and growth studies that could be representative for the entire region.
Panama	• Distrust of fishing sector towards biological data collection; • Lack of physical space on vessels for at-sea observers; • Lack of geographic location (VMS) in the small-scale fleet.	• Implementation of fishing logbooks • Awareness workshops to improve relationship with the fishing sector • Adoption of electronic monitoring
Costa Rica	• Discrepancies catch data from different sources (FAO vs. INCOPESCA) • Lack of data in tourist/sport fishing • Limited information available for small-scale fleets • Need to strengthen institutions to collect data (capacity building) • Uncertainty regarding funding for data collection (IATTC/Central America sampling)	• Experience with regional integration • Integration of oceanographic data; • Willingness of the productive sector to collaborate • Use of historical data from hotels and charter companies for sport fishing • Regional data collection program already developed (IATTC/Central America)
Guatemala	• Scarcity of human and funding resources; • Lack of standardization in data collection methodologies (size/maturity scale).	• Participation in regional databases • Support from NGOs and industry through Fisheries Improvement Projects (FIPs).

CPC	Challenges	Opportunities
Mexico	• Guarantee a reliable and truthful record of collected information	• Strong commitment and inter-institutional collaboration for data collection

2.2 Dorado catch estimates in the EPO

Dr. **Carolina Minte-Vera** presented "Dorado catch estimates for the Eastern Pacific Ocean" (DOR-04-15). This study aimed to identify if catch data stored in the IATTC are complete and possess the necessary information to use them in the next population assessment. By cross-referencing alternative data sources such as FAO catch, import, and export statistics, and U.S. import data, and comparing them with data sent to the IATTC by CPCs, it was estimated that dorado catches could be significantly higher than reported to the IATTC. Additionally, the data held by the IATTC lack information on fishing gear and fishing area. It was concluded that it is urgent to revise and improve reported data, incorporating detailed spatial information, fishing gear, and monthly disaggregation to correctly model the rapid dynamics of this species.

Discussion:

Differences in the catch data from different sources may be because: 1) In the IATTC, artisanal fishing may not be included; 2) Export data may not reflect reality as fish are sometimes frozen and stored until prices are better (for example, in 2023 there was high production and it was frozen to sell another year). 3) The pandemic caused problems with exports in 2021. It is important that, for the assessment (and monitoring), country experts indicate what would be reasonable catch values.

3. Conceptual model

Dr. **Carolina Minte-Vera** introduced conceptual models through a video presentation. Conceptual models summarize collective understanding of a system and helps form a solid foundation for building useful assessment models for fisheries management advice. The presentation (DOR-04-PRES-17) described the dorado stock conceptual model used in the last assessment, explaining how it integrates knowledge on biology (rapid growth, high mortality), fisheries (marked seasonality, concentration areas), and environmental variables (sea surface temperature). The last dorado population assessment in the EPO focused on the area where most catches occur, i.e., based on the hypothesis of a separated stock in the south. Preliminary results of a species distribution model (SDM) developped by the IATTC Ecosystems and Bycatch Program were presented to help discuss stock structure hypotheses. Comparison of SDM predictions for juveniles and adults in 2015 (El Niño condition) and 2016 (El Niño at beginning of year followed by La Niña) showed that areas of high probability of finding dorado in the North and South EPO were connected in 2015 and separated in 2016. SDM models can assist in developping conceptual models.

Four other presentations reported advances in genetic, tagging, and biology studies, which should be considered in updating the dorado conceptual model in the EPO.

3.1 Population Structure

Sofía Ortega-García presented "Genomic Characterization of Dorado Populations in the Eastern Pacific" (DOR-04-PRES-16), research conducted as part of the binational collaboration between Peru and Ecuador. This genomic study, developed in phases during 2019 to 2024, sought to define dorado population structure through DNA analysis of adult and juvenile samples. Preliminary results of the first phase (data collected 2019-2020, from Mexico to Peru, predominant neutral and La Niña conditions) identified three genetically differentiated regions (northern Mexico, equatorial strip, and southern Pacific) (Mar-Silva et al 2024). Female fidelity to specific sites was observed. Results of the second phase (2022-2024, data only from Ecuador and Peru) indicated separation in 2022 and high connectivity in 2023-2024 in that region

(predominant Niña conditions in 2022, followed by Niño and neutral). A new phase of the study is underway to complement sampling with juveniles, as DNA of good quality could not be extracted from several samples of juveniles. The influence of events like El Niño on genetic homogeneity was discussed.

3.2 Biology

Marilú Bouchon Corrales presented biological-fishery advances of perico/dorado in Peru, which has been the world leader in dorado catches since 2003, with an average of 45 thousand tons per year. Strong fishery seasonality driven by migratory behavior was highlighted; maximum availability is October to March, coinciding with seasonal sea warming. In cold months, the fleet alternates with fishing for squid and bonito. Eighty percent of Peruvian catches come from within the EEZ. In El Niño conditions, maximum dorado availability is in the center-south of Peru's EEZ, and in La Niña conditions, in the north. The fishery, dominated by longline (96%), shows a size structure with a mode between 60-80 cm and presence of juveniles at the start of the season. Larvae were found between 6^{o}S to 18^{o}S in oceanographic cruises conducted in regions near the coast. Diet studies indicated that juveniles predominantly consume anchovies and depend on coastal resources, while adults mainly consume flying fish and squid, indicating migration to warm oceanic waters. Reproductive peaks (high gonadosomatic indices) occur from October to April (austral spring and summer). Interactions with top predators (turtles and albatrosses) were recorded in the fishery.

3.3 Movement

Dr. **Christopher R. Perle** and Dr. **Stephanie Snyder Koch** reported initial results of a pilot study to understand transboundary movements of dorado in the EPO. This research is also part of the binational work between Peru and Ecuador. 111 specimens were tagged with conventional marks in the region between 8^{o}N - 5^{o}S and 85^{o}W - 105^{o}W, between July 2023 and August 2025 (Niño condition in 2023 followed by Neutral in 2024-2025). Six fish were recovered (recovery rate of 5%), three females and three males, all tagged in 2023. Preliminary results indicate sex-based dispersal patterns; females migrated towards the coast, including Central America, swimming against predominant currents, while males dispersed more rapidly with the currents. Authors discussed the influence of ENSO on population dynamics due to habitat contraction and expansion.

Maria Schoenbeck presented her doctoral thesis project aimed at evaluating ecological and socioeconomic impacts of climate change on the dorado fisheries. The author modeled dorado distribution (SDM) based on public domain data, mainly concentrated in coastal areas. SDMs identified sea surface temperature and chlorophyll as critical variables. The author used preliminary SDM results together with climate change scenarios (SSP 4.5 and 8.5) to project habitat changes for years 2040 to 2069. Results indicated that potential areas of habitat loss are where current dorado catches are highest. This study also plans to integrate socioeconomic dimensions through interviews with value chain players in Guatemala, Ecuador, and Peru, to evaluate fishery vulnerability and design adaptation strategies against changes in distribution and abundance patterns.

3.4 Discussion about the conceptual model

Participants discussed and sketched the conceptual model for dorado in the EPO, segmenting analysis by region of familiarity (Appendix 3). Consensus was that currents and sea surface temperature are determinant factors of dorado distribution and dynamics in the EPO. A map of currents, integrated with size distribution, is necessary to complete the conceptual model. Southern and northern currents in general do not mix, which could influence differences between populations.

From south to north, dorado dynamics were described as follows (see sketches in Appendix 3) :

Chile: North Chile is the southern extreme of the dorado distribution. Catches occur mainly in December to March (austral summer) and are highly variable, and smaller than catches for other species such as swordfish. Fish are adults (sizes >60 cm, 99.5% mature).

Peru: From October to November, juvenile dorado enter from the west zone towards Peru's territorial sea. In December, they reach the central zone of Peru, during spawning time. In southern Peru, the largest fish are found between January and May. In the area outside the EEZ and in central Peru is where interaction with top predators occurs. When anomalous warming events occur, dorado are located much further south, near the border with Chile. During 2025-2026, dorado began entering Peruvian waters through the north zone, entering through Paita (5ºS) around October, and until November it remained around 10ºS. Normally 80% of dorado arriving in Peru weigh two (about 50 cm) to four kilos (about 64 cm). In the 2025-2026 season, they were larger; half weighed more than four kilos. Until November they remained in Chimbote (9ºS); from there, different from other years, they rapidly moved south and in February settled at the Chile border (18ºS). In March, dorado were back between latitudes 10ºS and 9ºS, in smaller quantities.

The nursery area is possibly in Peruvian waters. Food availability (anchovy, giant squid) is important in the Peru region. Giant squid, which is an important part of adult dorado diet, is fished at 1.3 million tons per year. The giant squid fishery may be reducing dorado food.

In **Ecuador** there is a size gradient from north in Esmeraldas (0°57'N), where average is 95.5 cm, Guayaquil (2°S), 86 cm, and Santa Rosa (3°S), 75 cm. It is believed Ecuador and Peru share the same population, however, the difference in sizes caught in Manta and Esmeraldas indicates that catches unloaded in Manta come from the south and catches unloaded in Esmeralda come from the north.

The longline fishery is concentrated from December to March, or earlier according to oceanographic conditions. The Galápagos region is also important for dorado catches, according to the recently available data for class V and IV purse seiners. Part of Ecuador's dorado goes north, probably towards Colombia.

Colombia: The Humboldt Current that goes west has a branch that detaches, going north, and its normal direction is anticyclonic, going outward, almost year-round, from April to December, in a normal year. However, towards the end of December until March, trade winds from the north enter via Panama, and the jetstream arrives, causing all currents to reverse and start going down to the Cabo Corrientes zone in Colombia. The stronger current rides over the weaker one, and at that moment, the annual maximum productivity in Colombia's EEZ occurs. Then the current recovers it original direction. Juveniles would be more in Ecuador and would enter Colombia as adults. Only individuals in maximum reproductive stage and large sizes reach Colombia. It is very likely that there is also a group of adults entering from the oceanic side to feed or reproduce. Animals smaller than 40 cm do not enter, but larvae have been found in oceanographic cruises.

In **Panama**, with trade winds from January to April, there are temperature changes to less than 20°C, dorado become scarce, there is no production. From April to May, there is a temperature change to 25°C, and dorado become more common. Dorado catches follow a "W" during the year with more production in May and again another increase in the second semester. The observed reduction in catches coincides with the onset of the rainy season and may be attributable to decreased fishing effort under adverse weather conditions, rather than to a reduction in biomass availability. Towards the end of January and beginning of February, dorado would move south towards Colombia and Ecuador.

Costa Rica: There is variability in catch, but there is catch year-round and every year. The dorados are larger than 80 cm. Currents' direction are closely linked to wind patterns, which enhance marine productivity through upwelling processes. In the absence of these events, currents may reverse, leading to changes in

the region's oceanographic structure. This variability can influence the distribution of dorado, favoring a more oceanic distribution. Individuals originating from the north (e.g., from Mexico) may also move in nearshore waters.

In the external zone of the Gulf of Nicoya, or aroundthe Caño Island in the Guanacaste region, juveniles are found near the coast in some years, primarily to the north or primarily to the south. The dorado coming from Mexico southward during July to September are mainly small individuals. Between October and February, they are large and found in the center of the country. From March to July, towards the end of the season, they are large but lean. There is an important correlation with currents.

Mexico: In general terms, two distinct movement patterns of dorado are observed in Mexico: one coastal and another more oceanic. In the region of the Intertropical Convergence Zone (ITCZ), which is located further south from January to March and subsequently shifts slightly northward, combined with the influence of the trade winds, a transition zone is formed. In southern Mexico, specifically in the state of Oaxaca, a bimodal distribution of catches is observed throughout the year, with one peak occurring between October and November and another between February and April. However, according to Oaxaca (17°N) fishermen, this dynamic has changed considerably over the last three years (2023–2025), with catches declining significantly. In Manzanillo (19 °N), in the state of Colima, a mid-sized pelagic longline fleet operates with a permitted allowance of 10% bycatch of dorado. Based on these catches, two modes are also identified: a main one from September to November and a secondary one from January to March. Sampling conducted in Mazatlán (23°N), in the state of Sinaloa, has reported a run of small individuals arriving in May, or in June if the phenomenon is delayed. This run utilizes the Costa Rica coastal current before entering the Gulf of California (23°N). Dorado is caught in the state of Sonora (29°N), on the eastern side of the Gulf of California, and can migrate to the western side of the Gulf, where it can be fished in Santa Rosalía (27°N), in the state of Baja California Sur. Genetic studies have observed that dorado from Loreto (26 °N), located on the western side of the Gulf of California, south of Santa Rosalía, show weak connection with dorado sampled in Cabo San Lucas (23°N). Dorado from Mazatlán partially ascend into the Gulf and then migrate to the outer part of the Baja California peninsula, where they feed on sardines. In some years, particularly under El Niño conditions, they can reach as far as southern California (33 °N), USA, before migrating back southward. Dorado tagged with conventional "spaghetti" tags off Bahia Magdalena (25°N), on the western coast of Baja California Sur, have been recovered off Mazatlán in Sinaloa, Puerto San Blas (21°N) in Nayarit, and Punta Pérula (20°N) in Jalisco. According to satellite tagging studies, dorado marked off Bahia Magdalena also shows movements toward more oceanic areas. Dorado use part of the North Equatorial Current to move into oceanic waters, where they may associate with floating objects. Furthermore, due to the currents present in the region, they can return closer to the coast.

Connectivity among areas

Larvae, eggs, and very small animals are at the mercy of currents, suggesting the existence of a filter in the zone north of the area of influence of the Peru-Chile Current. The center of biomass and production is concentrated in the south; however, depending on climatic conditions, this "filter" can weaken, allowing large individuals to pass northward. Nevertheless, it remains unclear how the dynamics of the northern part (Mexico and the U.S.) connect with the rest of the population. Coastal and oceanic areas are connected. A crucial element is to integrate genetic analyses with the behavior of juveniles and adults, as well as with the transport of eggs and larvae. It would be valuable to identify which oceanographic factor or combination of factors—winds, currents, or temperature—is the dominant driver of dorado distribution.

In this context, the "accordion effect" of the habitat must be considered: when a separation occurs between north and south of the EPO, it does not necessarily imply the existence of two distinct stocks, but rather one that is temporarily divided. Questions arise regarding how long such a separation would need to last to generate significant genetic differences. Additionally, it is important to highlight possible differences in the behavior of adult males and females. Although the sample size in tagging studies is small, results indicated that males swim with the current, while females swim against it. This correlates with the sex ratio of landings in Ecuador used in the last assessment, which showed a much higher proportion of females in the catches.

Finally, management measures applied in Ecuador and Peru are fundamental if there is a connection towards Colombia, since the large fish arriving in Colombia are likely the survivors of the high fishing pressure in the south. Taken together, all this evidence suggests that dorado in this region could function as a meta-population.

4. Stock assessment

Three models were presented: a production model, a depletion model, and the integrated model used in the last assessment, structured by age and sex and fitted to size data and abundance indices.

Dr. **Elmer Quispe-Salazar** presented a JABBA model used for the population assessment of dorado in Peru (DOR-04-PRES-20). JABBA is a state-space production model. The hypothesis of a differentiated population unit in Peru was used, based on results from the first phase of the genomics study. It is based on time series of landings from the Peruvian fleet and was fitted to an abundance index derived from the CPUE of the Peruvian fleet, standardized using spatio-temporal GLMM models (2001–2025) using Bayesian methods. The results indicated that the stock is in a favorable condition, with relative biomass above the limit reference point and fishing pressure below the reference level. It was proposed to incorporate more environmental variables in the future and to conduct a Management Strategy Evaluation (MSE).

Dr. **Ruben H. Roa-Ureta** presented a dorado stock assessment using generalized depletion models (DOR-04-PRES-23). The presentation compares two spatial structure hypotheses (single shared stock vs. separate stocks for Peru and Ecuador) using multi-fleet generalized depletion models (6 fleets in total) with monthly data from 2004 to 2023. After analyzing catch, effort, and mean weight data from 2004 to 2023, the results indicate that the single common stock model is statistically more robust and biologically more plausible, as it better reflects south-to-north migration and shows a stable biomass of 0.5 million tons with a sustainable exploitation rate; conversely, the two-stock model suggests the Peruvian population would be near its limits while the Ecuadorian one would not be impacted, although this discrepancy is considered less consistent with migration evidence. The assessment concludes that the stock is stable and exploitation is sustainable under both hypotheses but recommends adopting the single-stock model for future management decisions and proposes integrating environmental dynamics such as El Niño–Southern Oscillation into future biomass models.

Dr. **Carolina Minte-Vera** presented "Assessment using the Stock Synthesis 3.0 model" (DOR-04-PRES-22). This was the model used in the 2016 dorado assessment in the EPO. The model is structured by age and sex and integrates monthly catch data, size composition, and standardized CPUE from Peru and Ecuador, assuming a monthly dynamic with strong recruitment seasonality, rapid growth, and high natural mortality ($M=1\ year^{-1}$). Essentially, it is a depletion model as it considers a single recruitment event per year and that fisheries reduce biomass during the year. The model included data from the years 2007 to 2014, only from the core catch area, i.e., catches from Peru and Ecuador. The model uses the concept of a fishing year: the year in the model starts in July, when the fishing season begins, and goes until June of the following calendar year. The model fitted well to the abundance index derived from the CPUE of the

Ecuadorian fleet and to size compositions. For the Ecuadorian fleet, size data were available by sex, and it was necessary to assume different selectivity between males and females due to the high proportion of females in the catch. The base case results, which no stock-recruitment relationship, show historical trends in recruitment, total biomass, spawning biomass, and fishing mortality. Estimated recruitment in the base case varied from 30 to 50 million individuals. Spawning biomass of females was on average close to 20,000 tons, with little variation, and the reduction was around 20% of the unfished spawning biomass. This model is flexible to accommodate different selectivities among fleets, sex specific growth and selectivity. The model provides a key tool for fisheries management of this species in the region.

Discussion:

The discussion focused on comparing the assessment models presented. Spawning biomass in the SS3 model was 20% of the virgin spawning biomass on average during the assessment years, whereas in the other models presented, it was a much higher proportion. Fishing mortality was also estimated to be much higher in the SS3 model compared to the other models, where catches had virtually no effect on biomass. Why is there such a large difference between models? It was emphasized that when there is model misspecification, there are limitations in fisheries assessment models to measure the relationship between catches and biomass. This was illustrated with the case of northern albacore, where the lack of spatial separation by life stage (juveniles vs. adults) in the model distorted the initial results. It was explained that the assessment model could only measure the effect of fishing when migration and spawning were incorporated, allowing the separation of catches from fleets like the Taiwanese fleet that operated in multiple areas with different sizes available. Models are tools that require critical thinking and constant review; if they do not represent reality well (for example, by requiring large biomasses or incorrect mortalities), they must be revised. Biomass dynamics models aggregate growth, mortality, and selectivity into just one parameter, which can be too simplistic for assessing stocks with multiple fleets (and selectivities) and spatial dynamics. Conceptual models help in specifying assessment models that are closer to reality and more useful.

Finally, it was asked what specific data (such as set logs, mothership GPS, CPUE, and sizes) participants could provide for a joint model and what the deadlines would be for submitting them before the next assessment. Those themes will be reported in the next item.

4.1 Available Information

4.1.1 Data

The participants listed the data available for the assessment and other analyses. Information that countries already possess and will share for the assessment and other analyses (Table 2). It was also sugested to extend the invitation to absent countries, OSPESCA, and other institutions to make their contributions.

Table 2. Data available by country and institution, represented by participants of the 4th Technical Meeting on Dorado, to be contributed to the next dorado assessment and other analyses and research.

Country	Type of Available Data / Contributions	Institution / Point of Contact
Peru	• Monthly catches (1990–2025) • Monthly abundance indices: CPUE with trip information (hold capacity, number of hooks, latitude, and longitude) (2001–2025) • Size composition and length-weight relationship (monthly) • Regulations on management measures implemented in Peru	**IMARPE** Marilú Bouchon mbouchon@imarpe.gob.pe

Country	Type of Available Data / Contributions	Institution / Point of Contact
Peru	• Landing logbook (electronic format/app) • IMARPE port sampling and PRODUCE Transparency Portal	**Vessel owners**
Ecuador	• Monthly landing volumes by port (motherships and fiber vessels) • Size/sex data by port • Weight/sex data (50%) • CPUE (fishing days / number of trips)). • Size structure (with and without origin) • Trophic ecology • Sexual maturity	**IPIAP** Manuel Peralta y Esteban Elias
Ecuador	• Specific fleets: Steel longliners (Swordfish 2023–2025 and Tuna 2018–2023) and Tunas purse seiners class 4 and 5 (2018–2025) • Environmental variables: Sea surface temperature data • General data: Catch by area/month, sizes, and sex (sex data only for longliners)	**Conservation Mahi-mahi** Guillermo Moran V.
Colombia	• Size structure (with and without origin) • Trophic ecology • Sexual maturity	Sandra Muñoz
Panamá	Data by fleet type defined by fishing zones: • Longline vessels operating in coastal zones within Panama's EEZ: Total Catches (2015–2025) Size, weight, and sex data (2024–2025) • Coastal vessels catching dolphinfish incidentally and operating in coastal zones within Panama's EEZ: Total Catches (2015–2025) • Longline vessels operating in international waters: Total Catches (2021–2025) Effort per set (2021–2025) • Purse seiners: information already submitted to the IATTC	**ARAP** Yesuri Pino
Panamá	Biometric data taken at processing plants (2022–2025)	**CEDEPESCA** Anabel Barría
Costa Rica	Data by fleet: • Small scale: Gear, catches (invoices), biometrics, gonad analysis. • Medium/Advanced: VMS, landing inspection, biometrics by sex. • Sport: Tournament records (data needs to be consolidated) • Tagging data (Gray Fishtag Project)	**INCOPESCA** Executive direction (Nelson Peña)

It was noted that CPCs not listed in Table 2 and OSPESCA should be contacted for data submission and participation in the collaborative work.

Additionally, CIAT already has the following data:

• Data obtained by purse-seine observers (catch per set and length class).

• Catch and effort data for purse-seine fisheries (mainly class VI vessels).

• Data from artisanal fisheries (ABNJ I and II projects).

• Length data from artisanal fisheries (super-sampling).

• Data from longline observers.

4.1.2 Priorities for Data Collection

Participants also indicated priorities for data collection, which include the standardization of procedures and collaboration between countries:

- Harmonize data collection procedures for biological data (e.g., reproductive data) and fishery data (e.g., catches and sizes).
- Share/evaluate tools (forms) validated by the IATTC and OSPESCA for the artisanal fleet (IATTC ABNJ project field teams are available to provide training on data collection).
- Develop standards/procedures for submitting information to the IATTC (e.g., SAC-15-INF-R).
- Collect information on sport/recreational fishing in each country.
- Seek funding to conduct data collection and dorado studies (human resources and financing) for national institutes.

4.2 Objectives for Dorado Research and Stock Assessment

Participants discussed their wishes and objectives for dorado research and stock assessment, with some points of greater interest for participants from different countries (Table 3).

Priorities are:

- Evaluate whether available information is sufficient to meet objectives; if not, define strategies to cover information gaps.
- Consolidate the conceptual model for the dorado/perico population in the EPO, including different hypotheses regarding population structure.
- Investigate stock structure:
    - Confirm populations through genetic analysis (2 years).
    - Confirm populations through geospatial distribution analysis (3 years).
- Biology studies:
    - Analyze larval distribution to identify areas where reproduction occurs successfully.
    - Analyze the dorado food chain.
- Assessment:
    - Integrate environmental information, including data on temperature, salinity, marine currents, and winds.
    - Develop indicators.
    - Estimate biomass.
    - Determine the stock status.
    - * Consider two hypotheses for stock structure assumptions in the assessment:

H1: Separate stocks:

1) Stock limited to Peru and Ecuador: Update the most recent assessment (where it was assumed Peru and Ecuador share the same stock) and compare the assessment with the depletion model fitted to Peru and Ecuador data.

2) Jointly analyze data from Central and North America.

H2: Connected stocks: Extend the analysis to a larger area using available information.

- Incorporate Management Strategy Evaluation (MSE) into the work, considering different management procedures (from data collection to the implementation of catch control rules).

Table 3. Wishes/Objectives to be achieved through collaborative work on dorado

Country	Wishes/Objectives to be achieved through the analyses
Peru	• Establish conceptual model • Integrate environmental information • Incorporate Management Strategy Evaluation (MSE))
Ecuador	• Estimate biomass • Estimate stock status |
Colombia	• Estimate stock status • Confirm population structure using genetic techniques. • Study geospatial distribution |
Panama	• Joint analysis of Central and North American data • Separate analysis of southern data. • Analysis of the dorado food chain. • Include data on temperature, salinity, marine currents, and winds.
Costa Rica	• Determine the number of stocks • Estimate biomass • Produce indicators

Deadlines:

- Investigate the number of stocks:
    - Confirm populations via genetics (2 years).
    - Confirm populations via geospatial distribution (3 years).
    - Analyze larval distribution to see where reproduction occurs successfully.
- Stock assessment: SAC meeting of 2027.

4.3 Assessment Work Plan

Conceptual model:

1. Finalize the conceptual model, including alternative hypotheses on population dynamics.
2. Incorporate environmental data to strengthen the conceptual model.
3. Use size, VMS, and country-specific knowledge to define the fisheries that will be included in the model.

Catches:

1. Review catch data and incorporate them into IATTC databases at the model scale (by month and fishery—vessel type, gear type, and area of operation).

Effort:

1. For countries that have already calculated this information, submit effort data as well (in number of days, sets, or number of hooks used). Other countries should estimate total effort.

CPUE and size data:

1. List all data.
2. Discuss data incorporation with the IATTC Data Group.
3. Submit data to the IATTC via focal points.
4. Incorporate data into IATTC databases.
5. Conduct exploratory analyses.

Assessment model:

1. Build a preliminary Stock Synthesis model using the data and approach from the Roa et al. model.
2. Incorporate size and catch data from other fleets.
3. Obtain abundance index(es) for the population.

Risk analysis

1. List the scenarios to be modeled.
2. Implement in Stock Synthesis models.

The timeline will be:

First half of 2026: Submission of data (CPUE, sizes, catches) by the CPCs.

Second half of 2026**:** Progress report and pre-assessment workshop (preferably in September 2026, within the context of the Mahi-mahi Working Group).

2027: Presentation of the final assessment document at the 2027 SAC meeting.

Assessment Work Deadlines

1. Send countries indication of catch information gaps: March 2026.
2. Submission of CPUE, size, and catch data: April 2026 (for countries represented at this workshop; confirmation required for absent countries or those represented only by researchers).
3. Progress Report: May 2026 (document) – Presentation at SAC 2026.
4. Potential IATTC Pre-assessment Workshop: Date to be defined before the end of 2026 in Peru (two-day workshop, following the binational Peru-Ecuador dolphinfish workshop, or promoting a regional workshop). Several participants (including SFP-COREMAHI) offered support for this workshop.
5. Final Assessment Document: Tentative submission at SAC **2027**.

5. Suggestions for the operation of the Working Group on Dorado

Participants discussed several aspects that could be useful for the functioning of the IATTC Working Group on Dorado (WGD):

• Appointment of two co-chairs for the WGD, one representing the south and the other representing the Central American and northern areas, given the heterogeneity of dorado population dynamics in the EPO.
• Continuation of the work initiated at DOR-04 within the framework of the WGD.
• Encouragement of regional collaboration through the exchange of methodologies and experiences.
• Strengthening of regional data collection programs, including tagging.
• Harmonization of the collection of biological and fishery data.

- Search for funding sources (including for human resources) to support the development of scientific knowledge, stock assessment, and monitoring of dorado.
- Inclusion in the agenda of the first WGD meeting a pre-assessment workshop when an account of progress on the stock assessment will be given.

Appendix 1. Agenda

SCHEDULE:
8:00 Tuesday only: registration (open all day)
9:00 Start (except Tuesday: opening at 8:30)
10:30-10:45 Break
13:00-14:00 Lunch
15:30-15:45 Break
18:00 Adjournment (flexible)

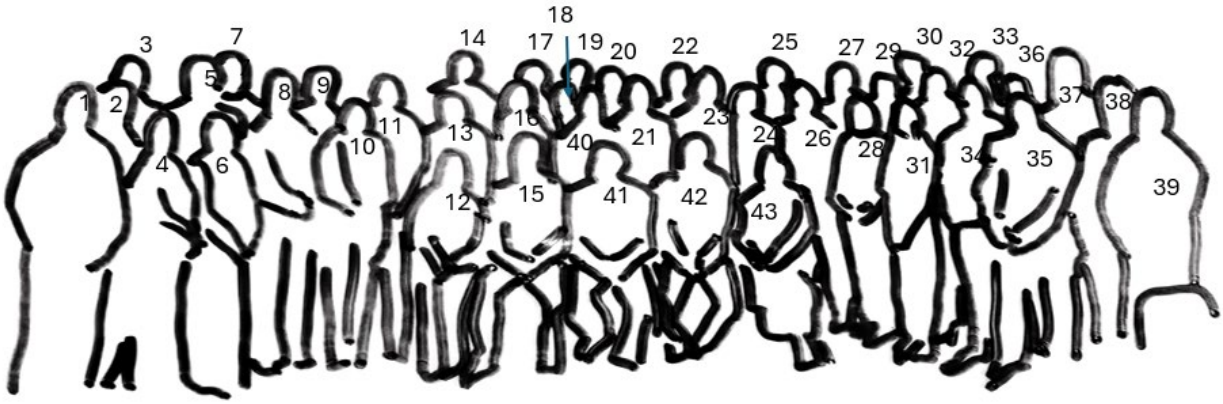
AGENDA ITEMS:
1. Inauguration and opening (beginning at 8:30 on Tuesday)
1.1. Welcome and background on previous dorado workshops
1.2. Background on dorado in the eastern Pacific Ocean and workshop structure
2. Updated fisheries knowledge (fisheries description, monitoring and data collection systems)
2.1. Short presentations by participants
3. Review of the conceptual model
3.1. Stock structure
3.2. Biology
3.3. Fisheries and associated data
3.4. Others
4. Dorado assessment:
4.1. SS3 model
4.2. Other options
5. Work plan
5.1. Update of the assessment
5.2. Need for a Management Strategy Evaluation
5.3. Proposals for the operation of the Working Group on Dorado
6. Others
6.1 Field trip to observe a landing
7. Adjournment

Day	Time	Activity	Person in charge	Institution
Tuesday		**Inauguration and opening**		
	8:00	Arrival at the venue and introduction of head table	Ana Victoria Paniagua, COREMAHI	
	8:30	Welcome	Victor Carvajal, Ministro de Agricultura, Costa Rica	
	8:45	Presentation of the event	Alexandre Aires-da-Silva, Coordinator of Scientific Research; Head of Scientific Research Division, IATTC	
	8:55	Inauguration and logistics	Ana Victoria Paniagua	
	9:00	Introduction of participants	Participants	
	9:30	Background on dorado in the eastern Pacific Ocean and workshop structure	Carolina Minte-Vera, Senior stock assessment scientist, IATTC	DOR-04-PRES-01
	10:15	Group photo	Participantes	
	10:30	Break		
		Updated fisheries knowledge		
	10:45	**Perú:** Monitoring system for dorado (Coryphaena hippurus) in Peru.	Sandra Cahuín Villanueva, Instituto del Mar del Perú (IMARPE)	DOR-04-PRES-02
	11:15	**Ecuador:** Monitoring of dorado fishery landings in Ecuador	Manuel Peralta Bravo, Instituto Público de Investigación de Acuicultura y Pesca Ecuador	DOR-04-PRES-03
	11:35	**Ecuador:** Biological data for dorado (*Coryphaena hippurus*) reported in Ecuador during 2019-2025	Ministério de Agricultura, Ganadería y Pesca, Ecuador	DOR-04-PRES-04
	12:00	**Costa Rica:** Dorado fisheries in the Costa Rican longline fleet in the EPO	José Miguel Carvajal, Instituto Costarricense de Pesca y Acuicultura (INCOPESCA)	DOR-04-PRES-05
	12:30	**Colombia:** The dorado Fisheries in the Colombian Pacific	Luis Zapata, WWF Colombia y Emiliano Zambrano Rodriguez, Asociación Colombiana de Industriales Pesqueros -ACODIARPE	DOR-04-PRES-06
	13:00	Lunch		
	14:30	**Panama:** Dorado fisheries by longline vessels in Panama	Robert Duarte, Departamento de Evaluación de los Recursos Acuáticos, Autoridad de los Recursos Acuáticos de Panamá (ARAP),	DOR-04-PRES-07
	14:15	**Panama:** Fisheries in international waters: fishery of dorado by Panamenian vessels	Yesuri B. Pino, Unidad para el Seguimiento de OROP, ARAP	DOR-04-PRES-08
	15:00	**Central America:** Considerations about the dorado (*Coryphaena hippurus)* fisheries in central America	Ernesto Godelman (CEDEPESCA)	DOR-04-PRES-11 [recorded presentation]
	15:15	**Mexico:** Indirect indicators of the state of the dorado population in Baja California Sur	Sofia Ortega-Garcia, CICIMAR-Instituto Politécnico Nacional - México	DOR-04-PRES-13

	15:30	**IATTC:** Studies about coastal Fisheries in the IATTC – Summary of the ABNJ-1 and ABNJ-2 projects	Salvador Siu, Científico de pesquerías costeras y subregionales, CIAT	DOR-04-PRES-12
	NA	**Chile:** Diagnóstico de la pesquería del dorado de altura en Chile 2005-2025	Patricio Barría y Andrés González Instituto de Fomento Pesquero Chile	DOR-04-PRES-14 [not presented]
	16:00	Break		
	16:30	**IATTC:** Catch estimates of dorado in the eastern Pacific Ocean	Carolina Minte-Vera, IATTC	DOR-04-PRES-15
	17:00	*Discussion – challenges and opportunities for monitoring of dorado fisheries in the EPO*	Participants	
	18:00	End of daily activities		
	18:30	Welcome cocktail	COREMAHI	
Wednesday		**Conceptual model of dorado in the EPO**		
	9:00	Introduction to conceptual models Conceptual model for dorado in the EPO	Carolina Minte-Vera, IATTC	Video sobre modelos conceptuales DOR-04-PRES-17
	9:15	Genomic characterization of dorado *Coryphaena hippurus* populations in the Eastern Pacific	Sofia Ortega, CICIMAR-IPN, Muxico, Binational work Peru-Ecuador	DOR-04-PRES-16
	9:45	Advances in the biology and fishery of perico/dorado (*Coryphaena hippurus*) in Peru	Marilú Bouchon Corrales, IMARPE - Perú	DOR-04-18
	10:00	Break		
	10:15	Initial results of a pilot study to understand the transboundary movements of dorado (*Coryphaena hippurus*) in the eastern Pacific Ocean	Christopher Perle, California State University, Stephanie Snyder Koch, Thomas More University, Trabajo Binacional Perú-Ecuador	DOR-04-19
	10:45	Potential ecological and socioeconomic impacts of climate change on the dorado fishery in the tropical Eastern Pacific	María de los Ángeles Schoenbeck-Yanes, PhD candidate, Binational work Peru-Ecuador	DOR-04-PRES-21
	11:15	*Conceptual model discussion*	Participants	
	13:00	Lunch		
		Dorado assessment		
	14:00	Determination of the population status of the perico/dorado (*Coryphaena hippurus*) in the waters of the Peruvian sea using a Bayesian state-space production model	Elmer Quispe Salazar, IMARPE - Peru	DOR-04-PRES-20
	14:30	Stock assessment of mahi (*Coryphaena hippurus*) in the Eastern Pacific using generalized multi-year and multi-fleet depletion models, combined with surplus production models with an ecosystem approach (fisheries in Ecuador and Peru).	Rubén H. Roa-Ureta, Consultant, Binational work Peru-Ecuador	DOR-04-PRES-23 [presentación grabada]

	15:00	Dorado stock assessment model in Stock Synthesis 3.0	Carolina Minte-Vera, IATTC	DOR-04-PRES-22
	15:30	Break		
	16:00	*Discussion of the assessment work plan*	Participants	
	18:00	End of daily activities		
Thursday	**8:00**	Field trip to Puntarenas	COREMAHI	
	10:30	Unloading at the dock	INCOPESCA	
	12:30	Lunch	COREMAHI	
		Recommendations		
	14:30	Discussion of participants' technical recommendations for the IATTC Working Group on Dorado and research recommendations	Participants	
	15:30	Summary of results and adoption of recommendations by participants	Carolina Minte-Vera, CIAT	
	16:15	**Adjournment**	Nelson Peña Navarro, Executive Director, INCOPESCA	
	16:30	Return to San Jose		

Appendix 2. Participants



Group photo: Participants of the 4th IATTC Technical Meeting on Dorado, in San José, Costa Rica, from March 10 to 12 2026: (1) Jonathan Pincay Espinoza, (2) Jostyn Sánchez Vinueza, (3) Elmer Ovidio Quispe Salazar (4) Marilú Bouchon, (5) Robert Duarte, (6) Sandra Cahuin, (7) Salvador Siu, (8) Manuel Peralta Bravo, (9) Víctor L. Cevallos Lucas, (10) Mónica Gamboa, (11) Esteban Elias Méndez, (12) Carolina Minte-Vera, (13) Sofia Ortega-Garcia, (14) Rodrigo Sandoval, (15) Alexandre Aires-da-Silva, (16) Maria Schoenbeck, (17) Heather Luedke, (18) Bernald Pacheco Chaves, (19) Emiliano Zambrano , (20) Odalier Quirós, (21) Anabel Barría, (22) Mauricio González, (23) Rosa Runcie, (24) Carlos Yenque Carrasco , (25) Nixon Lara-Quesada, (26) Henry Juarez, (27) Pablo Morera, (28) Elsa Vega, (29) Bernal Chavarria, (30) Germán Pochet, (31) Carmen Morán, (32) Rafaella Parodi Horny, (33) Alexander Salas Jiménez, (34) Guillermo Morán V., (35) George Pinto, (36) Guillermo Morán B., (37) José Miguel Carvajal, (38) Moisés Mug, (39) Luiz Zapata, (40) Yesuri Pino, (41) Víctor Carvajal – Ministro de Agricultura y Ganadería - Costa Rica, (42) Nelson Peña Navarro, (43) Ana Victoria Paniagua.

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Appendix 3. Conceptual model sketches

Perú I

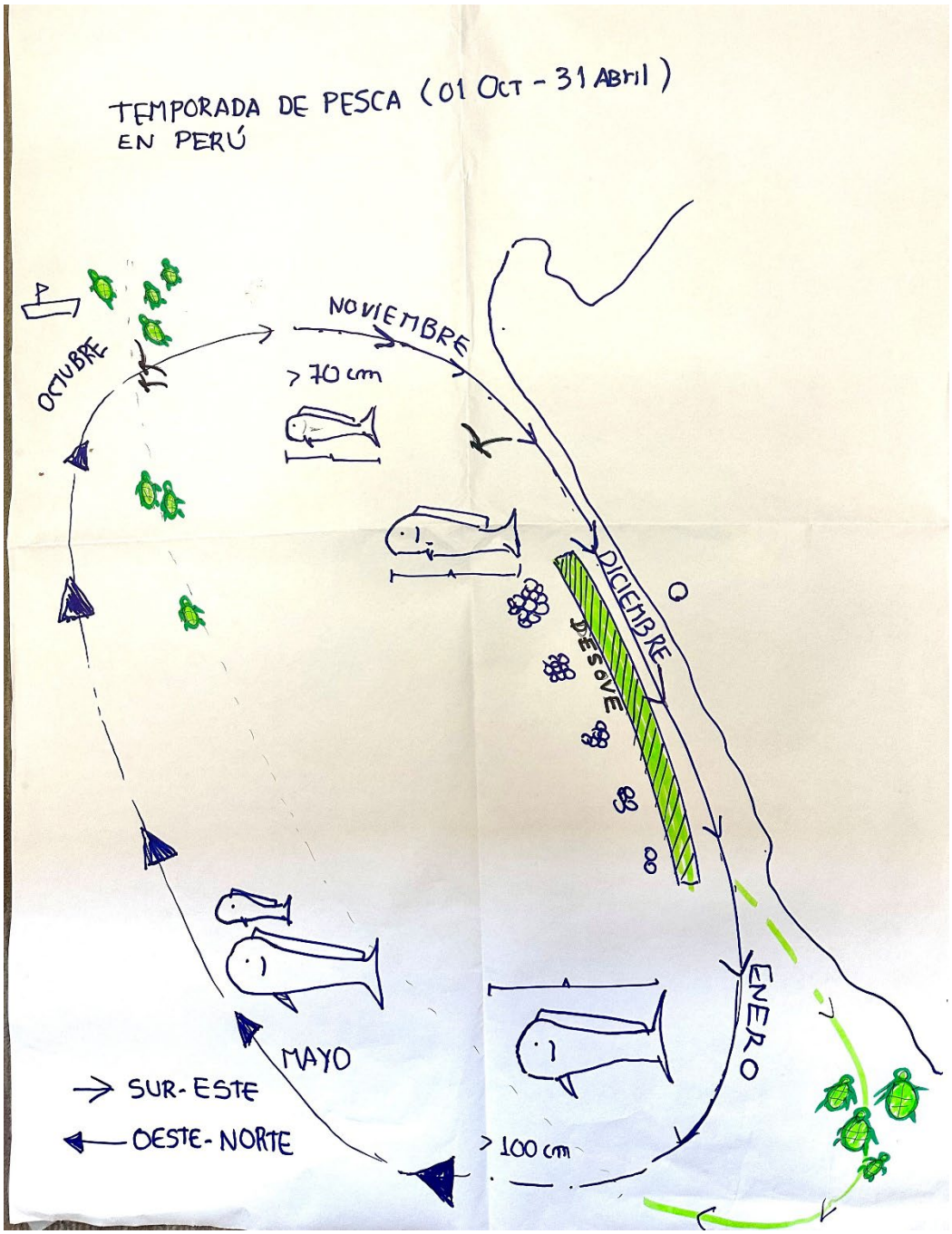

Figure A3.1. Conceptual model sketch for Perú and neighboring areas.

Perú II

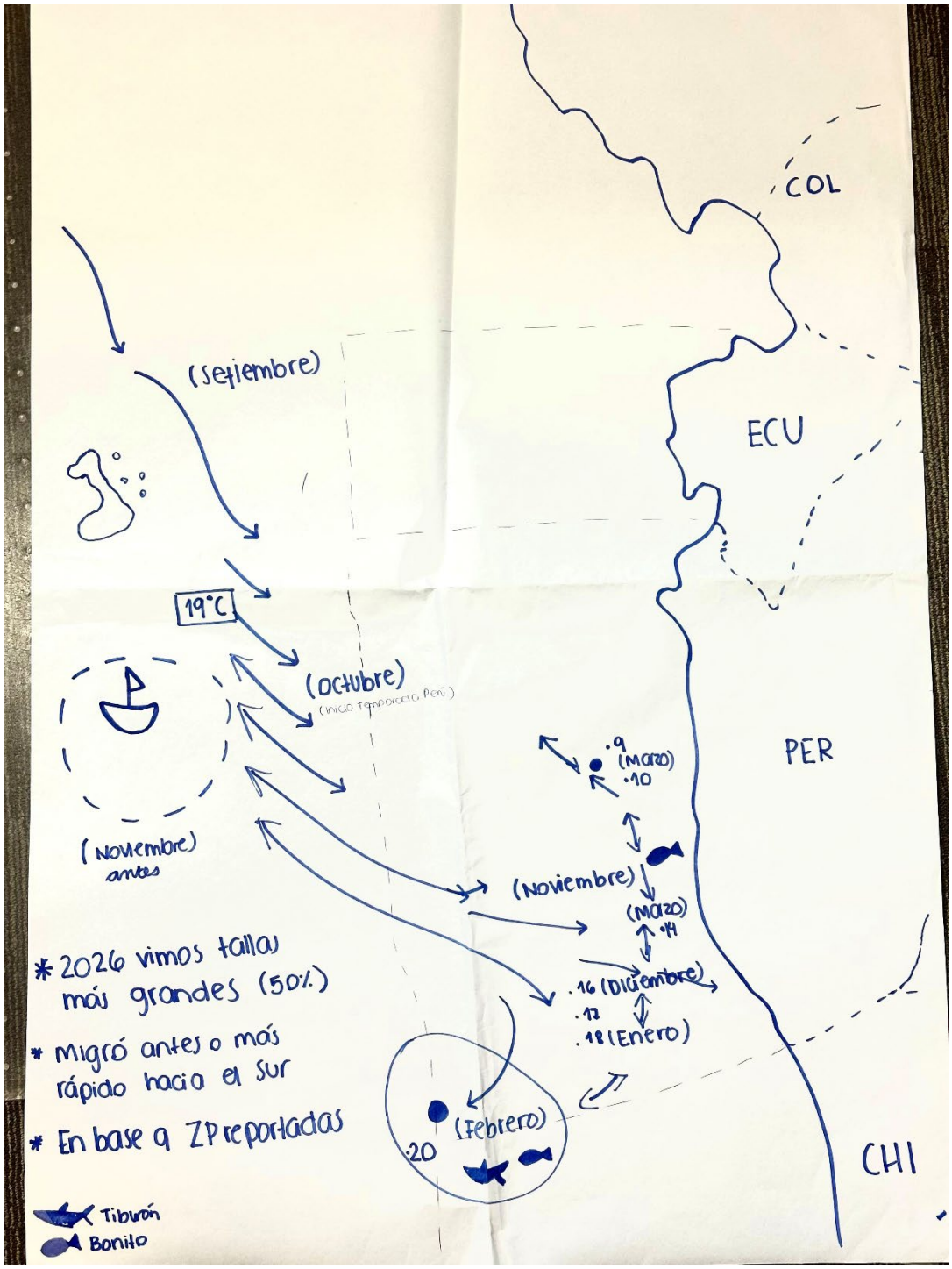

Figure A3.2. Conceptual model sketch for Perú and neighboring areas

Ecuador I

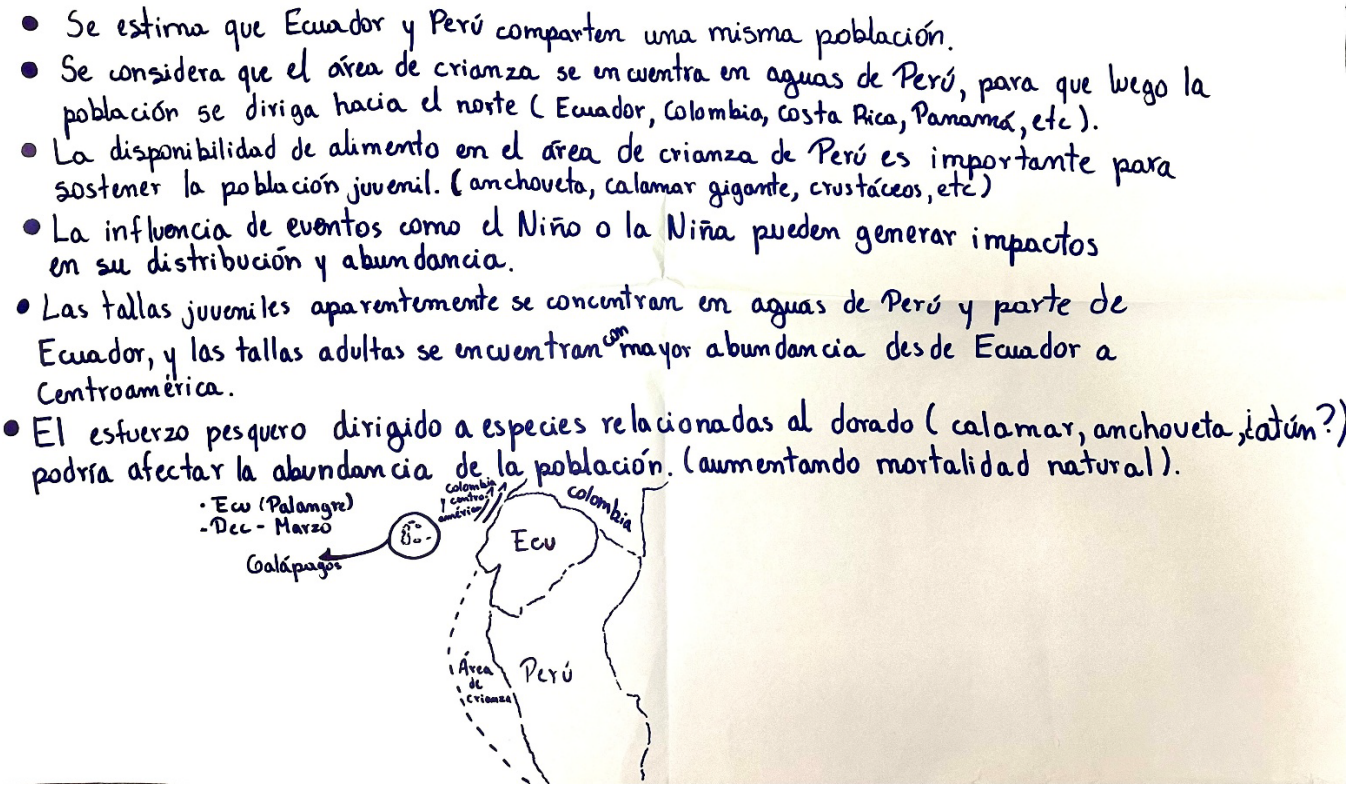

Figure A3.3. Conceptual model sketch for Ecuador and neighboring areas.

Ecuador II

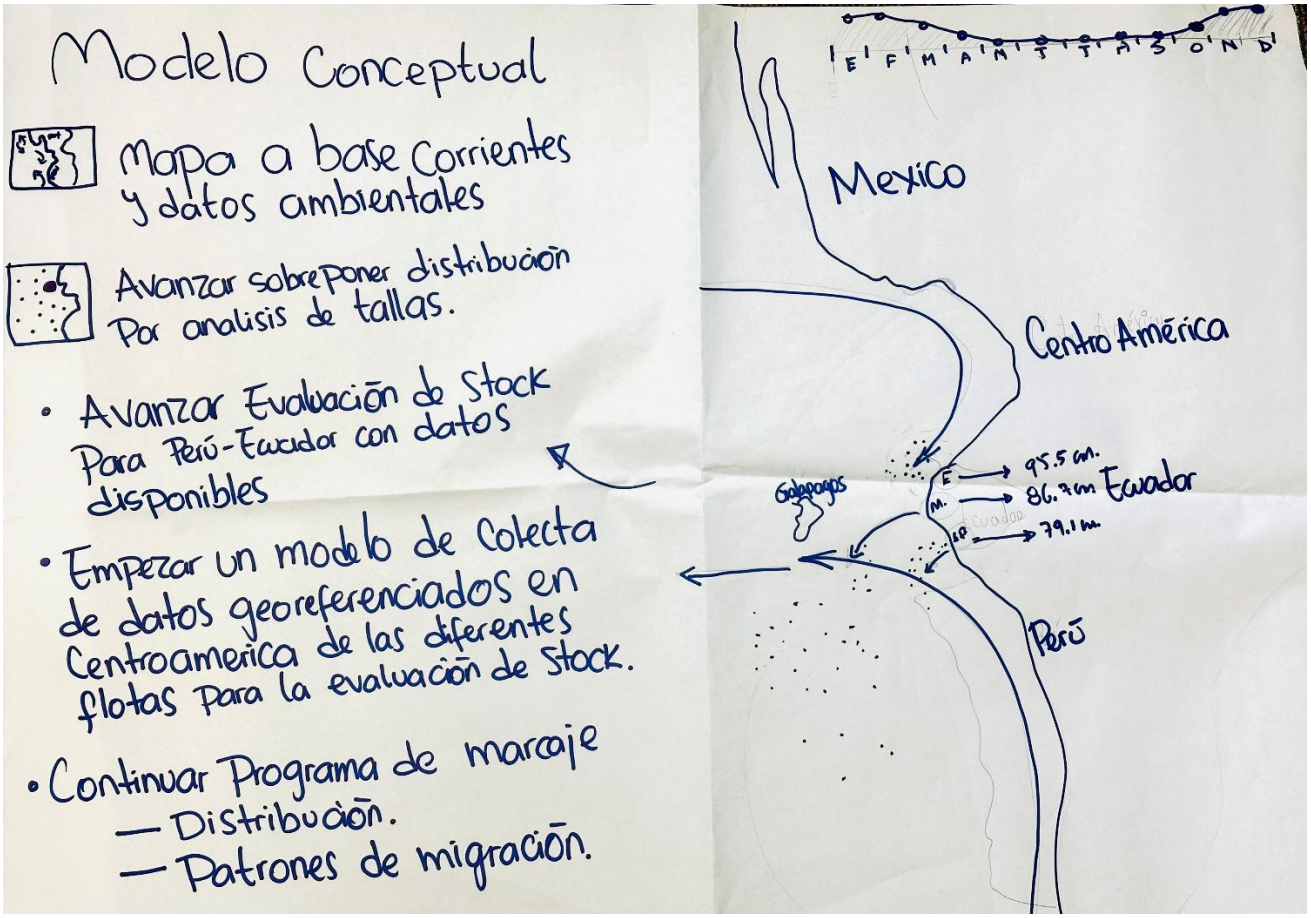

Figure A3.4. Conceptual model sketch for Ecuador and neighboring areas.

Colombia

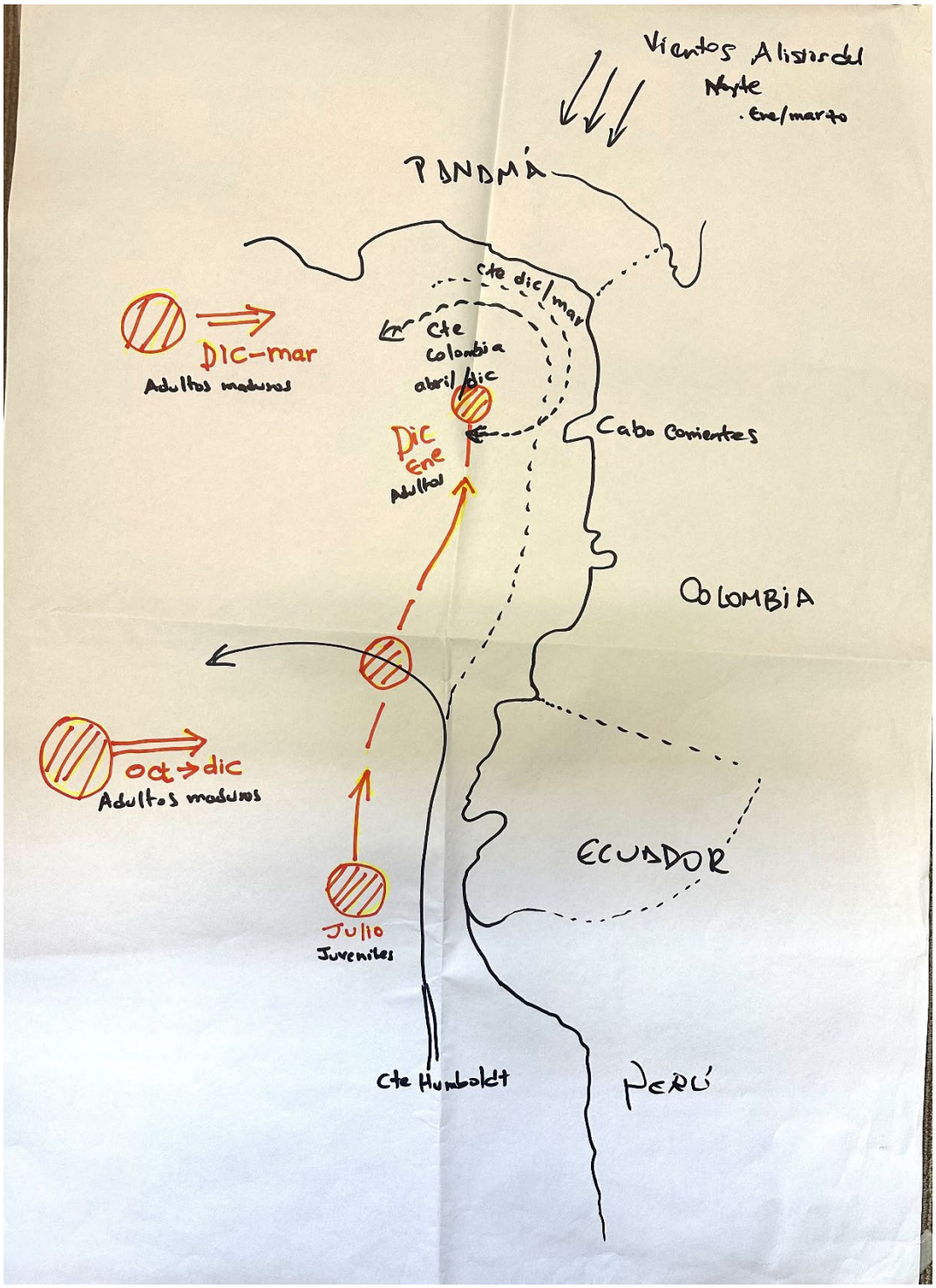

Figure A3.5. Conceptual model sketch for Colombia and neighboring areas.

Panamá

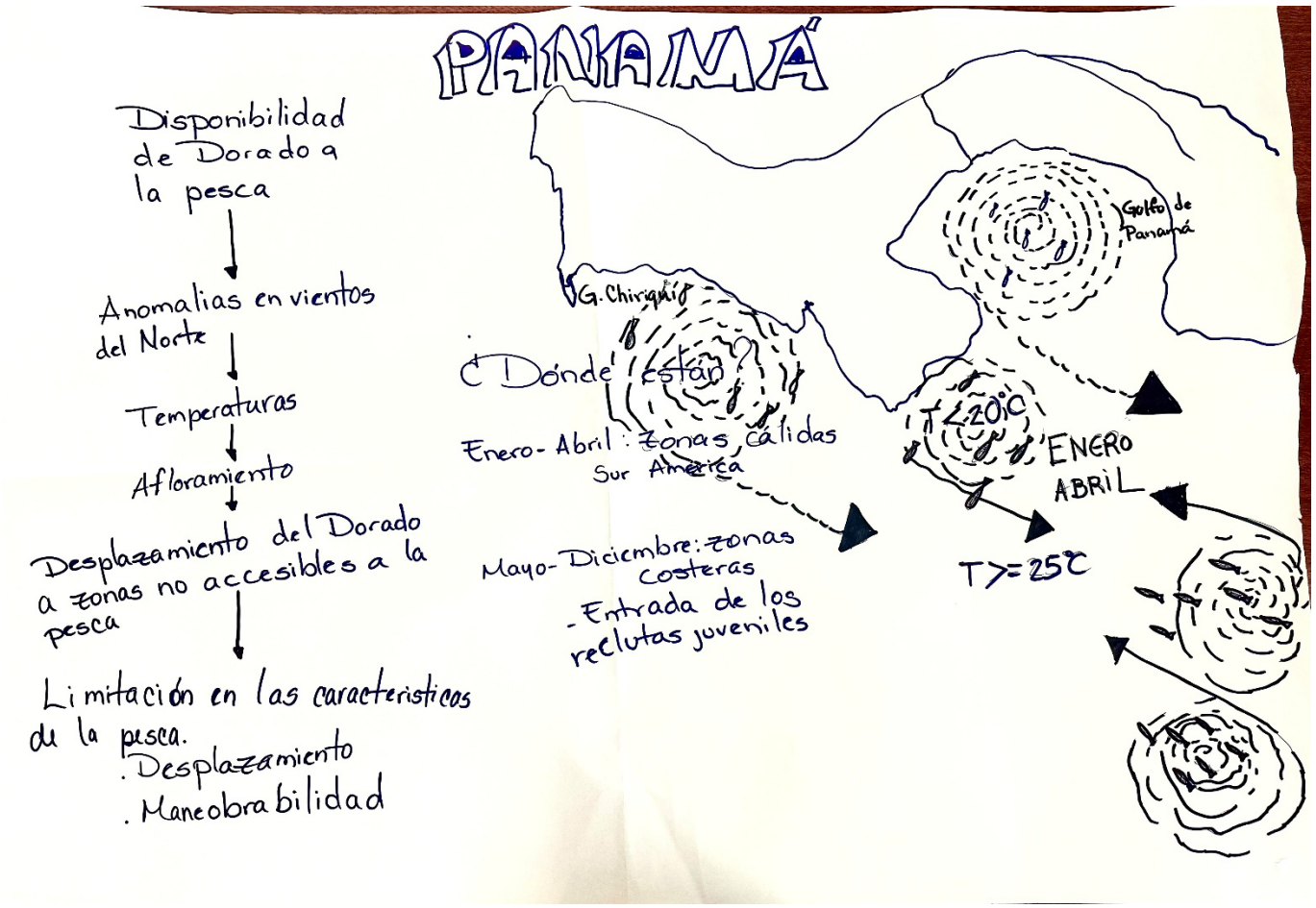

Figure A3.6. Conceptual model sketch for Panamá and neighboring areas.

Costa Rica

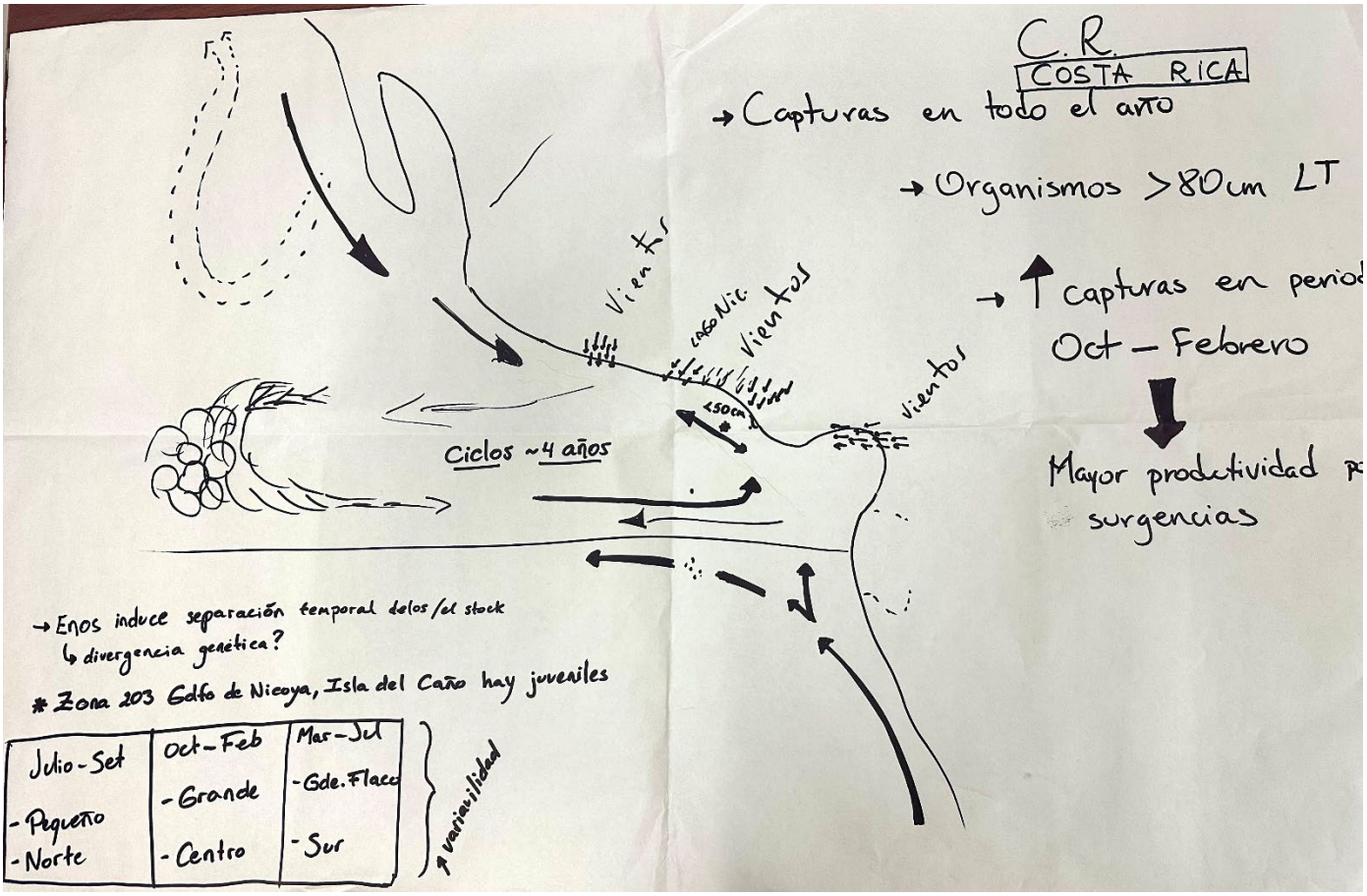

Figure A3.7. Conceptual model sketch for Costa Rica and neighboring areas

México

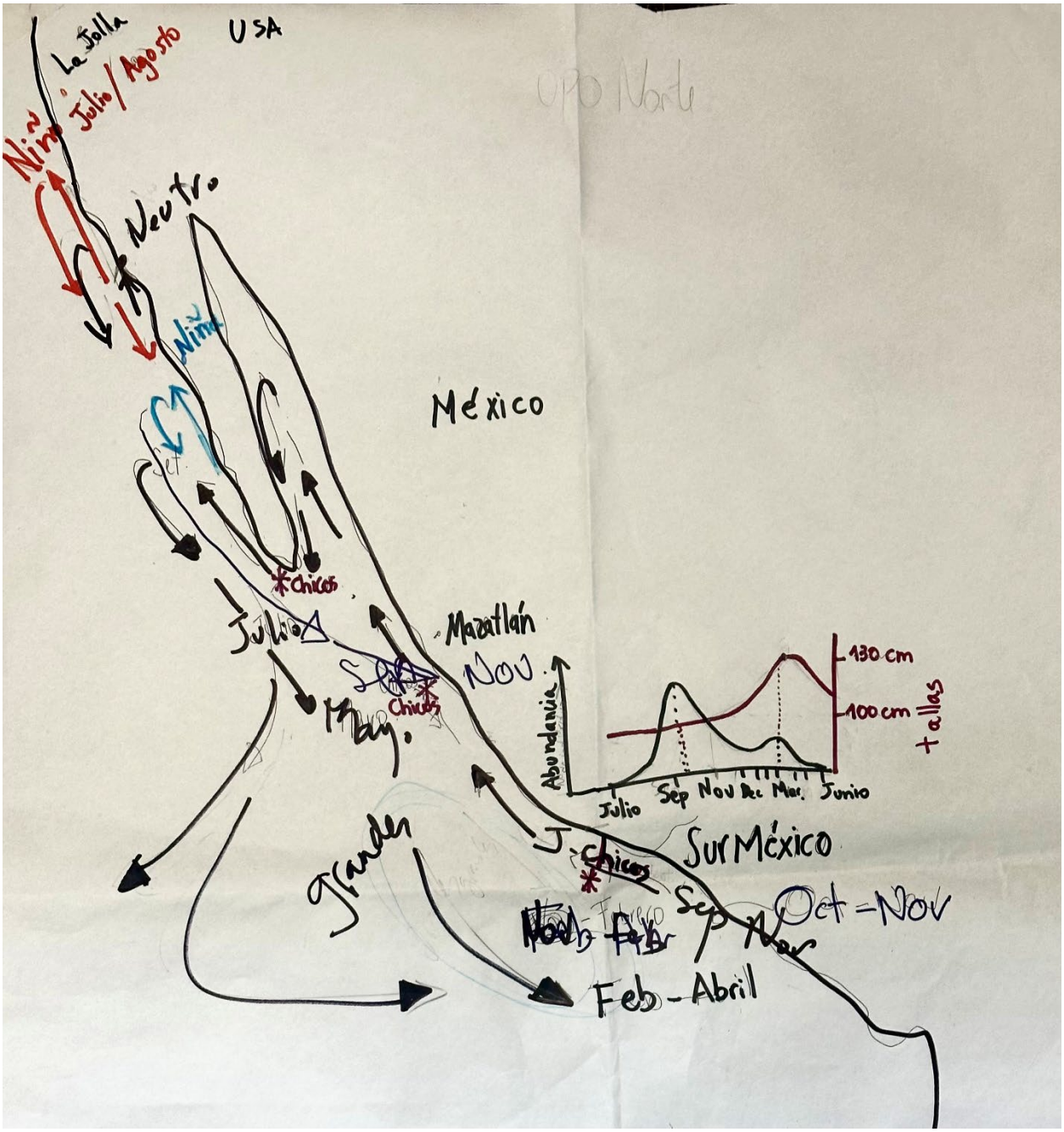

Figure A3.8. Conceptual model sketch for Mexico and neighboring areas

General

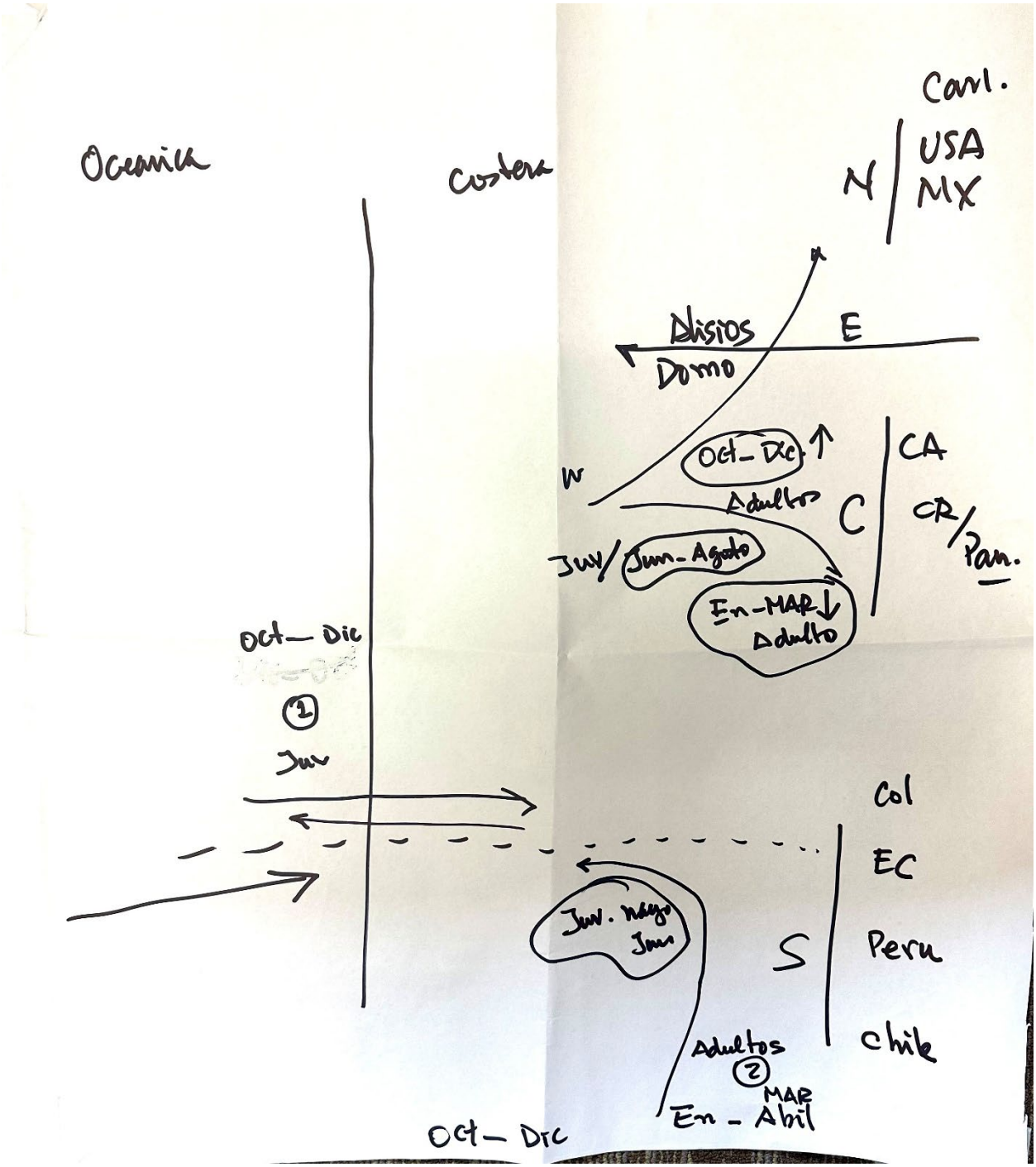

Figure A3.9. Conceptual model sketch for the EPO highlighting the coastal and oceanic components