MEXICAN NORM (NMX) THAT ESTABLISHES THE PROCEDURE FOR ENVIRONMENTAL FLOW DETERMINATION IN HYDROLOGICAL BASINS

Con el apoyo de la Alianza

WWF | Fundación Gonzalo Río Arronte, I.A.P. | CONAGUA Comisión Nacional del Agua

1. Background

Since 2004, the Alliance conformed by World Wildlife Fund for Nature (WWF) and Gonzalo Río Arronte Foundation, I.A.P. (FGRA), in collaboration with National Water Commission (CONAGUA) and others federal agencies, as well as academic institutions, Non-Governmental Organizations (NGO), water users and rural communities, has developed three different proposals of environmental flows (EF) in river basins with different conservation, water pressure and management contexts: i) Conchos river in Chihuahua; ii) Copalita-Zimatán-Huatulco rivers in Oaxaca; and iii) San Pedro Mezquital river in Zacatecas, Durango and Nayarit. From 33 sites analyzed in detail in the three river basins, in 73% of the cases EF occurs under current conditions; in 21%, management requires regulation in the conditions of water extraction and in operation of infrastructure; and only in 6% is necessary to make adjustments in user's water allocation. These results were systematized for the proposed Mexican Norm (NMx) (Figure 1).

Figure 1. Process to develop NMx from WWF-FGRA Alliance model

2. Scientific principles or foundations

Two core principles are followed to determine the hydrological requirements of aquatic ecosystems, and therefore they are the foundation of the EF Mexican Norm (Figure 2). These principles allow to identify valid EF methodologies and set a normative framework up.

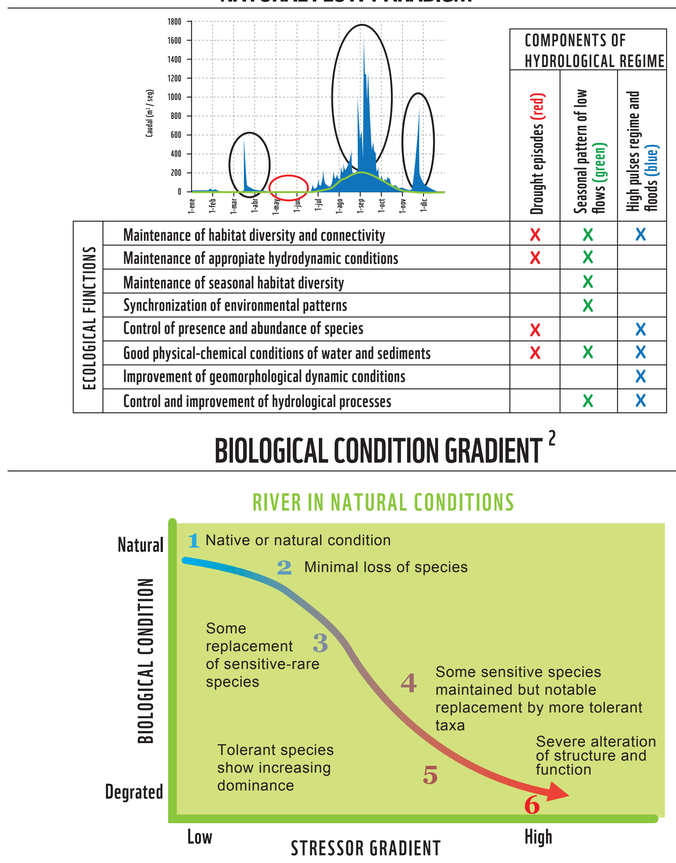

Figure 2. Scientific principles of the NMx

Any given methodology to determine EF regime will be valid if it leads to practice of the key scientific principles, for example:

- It must allow for understanding of the ecological significance of each flow regime component, and generate proposals from a functional point of view, for its conservation or reestablishment
- The proposal must consider the natural hydrological variability for ordinary (low flows) and extraordinary (high pulses and floods) conditions
- It recognizes that an aquatic ecosystem modifies its features in response to an increase in stress levels, and therefore, it allows adjustment to proposals to the environmental objectives or conservation of the river.

3. Objective

To establish the technical procedures and specifications for determining EF regime in streams or national water bodies in a hydrological basin.

4. Field of application

Water allocation, infrastructure, or any other work that involves water transfer among basins and the like, which requires an Environmental Impact Assessment. All streams and water bodies whose availability agreements published in the Official Government Gazette did not considered flows for aquatic ecosystems conservation.

5. Normative references of special interest for the NMx

NOM-011-CONAGUA-2000. Conservation of the resource of water – which establishes the specifications and methodology for determining the mean annual availability of the nation's waters.

NOM-059-SEMARNAT-2010. Environmental protection – Wildlife species of flora and fauna native to Mexico – Categories of risk and specifications for its inclusion, exclusion or change – List of species in risk.

6. General specifications

The described methods are considered as minimum technical requirements and do not exclude the implementation of complementary or more precise methods.

6.1. Environmental objectives

The EF regime should be determined based on the associated environmental objective, according to the basin's ecological importance and water pressure (**NMx– Technical Annex 1**), whether surface streams, water bodies of diverse kinds, or as part of the associated aquifer's natural discharge, to conserve and protect the environmental conditions and promote ecological balance.

Environmental objectives represent the ecological state that is intended to be obtained or preserved in the basin. They establish the relationship between the value of conservation (ecological importance) and its implication for the productive uses of water (water pressure) (Figure 3).

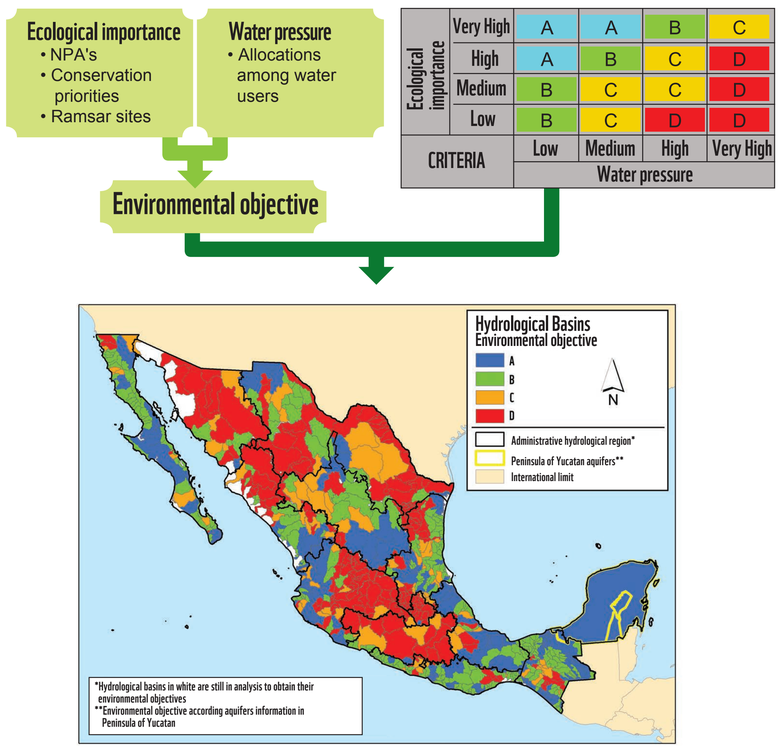

Figure 3. Conceptual model, criteria matrix and environmental objectives map

6.2. Methodologies

i. Hydrological (**NMx – Technical Annex 2, 3 y 4**)
   - Application: Without conflicts for water use and with hydrological regime unaltered (Figure 4)
     - Procedure based on reference values as percentages ranges of mean annual runoff and taken to a monthly scale

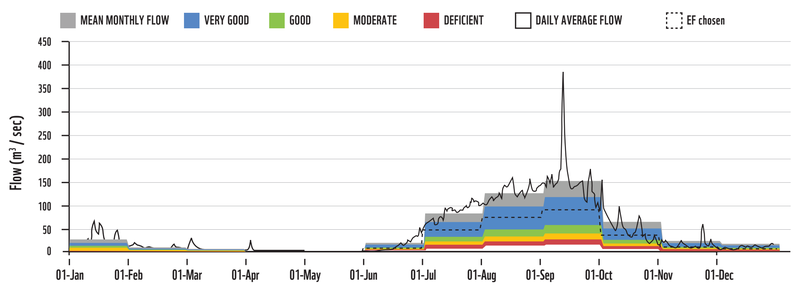

Figure 4. EF regime using reference values

   - Applicacion: With presence of water infrastructure (i.e. hydropower plants) and altered hydrological regime (Figure 5), the method should define:
     - Seasonal low flows regime for wet, average, dry and very dry hydrological conditions
     - Intra-annual (Type I) and inter-annual (low and mid magnitude – Type II and III, respectively) high pulses regimes with their respective attributes of magnitude, duration frequency, timing, and rate of change

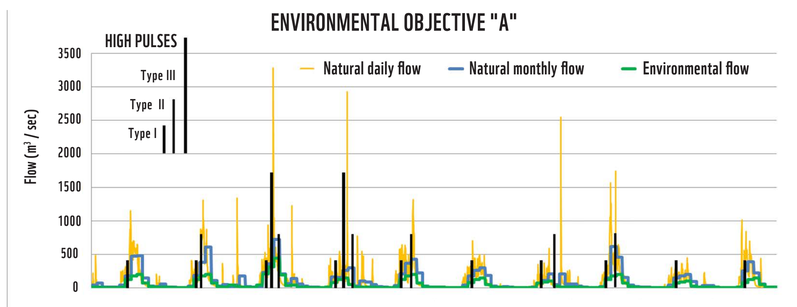

Figure 5. EF regime (low flows and high pulses) projected in a hypothetical period of 10 years

ii. Hydrobiological **(NMx –Technical Annex 5)**
   - Habitat simulation models to project the physical habitat and its changes due the flows. It has the purpose of quantifying habitat preferences of species, or one in particular that could be taken as an objective (Figure 6). Frequently in these models hydraulic variables are used in the determination of the connectivity of rivers, floods and channel capacities. Among the most used models are:
     - Instream Flow Incremental Methodology (IFIM)
     - Physical Habitat Simulation System (PHABSIM)

Figure 6. Methodological framework for EF analysis through physical habitat modeling according to preferences of certain species.

iii. Holistic **(NMx – Technical Annex 6)**
   - Highly recommended for those cases where detailed proposal of EF is needed or required due to a river's complexity, social conflicts or difficulties. Focused on particularities of the zone of interest, and specifically, identify the ecological significance of hydrological regime components and their relationship with the basin's ecological importance and the impact on water uses (Figure 7). Methodologies of this kind are:
     - Building Block Methodology (BBM)
     - Downstream Response to Impose Flow Transformation (DRIFT)
     - Benchmarking
     - Ecological Limits Of Hydrologic Alteration (ELOHA)

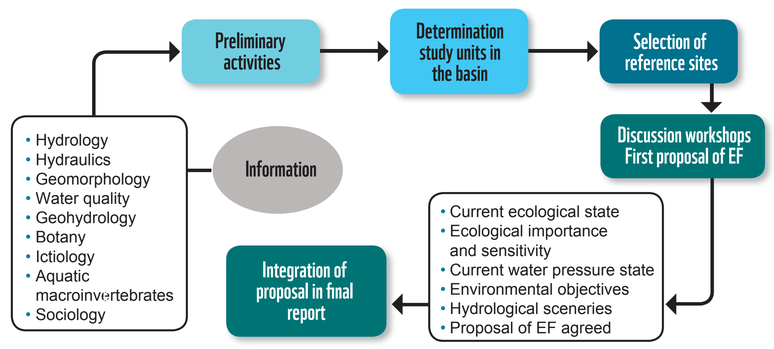

Figure 7. Conceptual model for an holistic methodology development

6.3. Environmental flows proposal content

EF Mexican Norm procedure results will be presented according to gauging stations located in the river basin (headquarters or highlands, midlands and lowlands) and at each sub-basin discharge. The report should have the following content:

i. Description of the hydrological basin
ii. Selection and characteristics of the sub-basin
iii. Environmental flows per basin
   a) Description of the methodology used, justification and preliminary determination of environmental flows
   b) Reference sites and proposal of environmental flows
iv. Annexes. Technical data and other detailed information of each analyzed reference site

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Federal Electricity Commission, National Water Commission, Natural Protected Areas Commission, National Commission for Knowledge and Use of Biodiversity, Institutes of Biology and Engineering of the National University of Mexico, Mexican Institute of Water Technology, National Institute of Ecology, Secretariat of Environment and Natural Resources, The Nature Conservancy and World Wildlife Fund for Nature, Inc. Mexico Program.

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