Selecting the Right Tools for Mekong Migratory Fish Research

Evaluating the benefits and challenges of fisheries research techniques

Project Lead
FISHBIO

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Scientists from FISHBIO and IFReDI tagging a Giant Freshwater Stingray with an acoustic tag.

Context and Objectives:

Research gaps related to the population dynamics, biology, movement, and habitat of Cambodia's migratory fishes make it difficult to effectively manage these economically and ecologically important species and address threats to their survival. A suite of existing fisheries research tools can be utilized to fill these data gaps and answer critical questions about migratory fishes. Researchers should weigh the strengths and weaknesses of each of these approaches and objectively select the most appropriate tool to address each research uncertainty.

The purpose of this brief is to help managers and researchers evaluate the benefits and challenges of various fisheries research tools and techniques when designing studies to address key knowledge needs for migratory fishes. Fisheries-dependent approaches, such as fish catch monitoring, have historically been the most widely used methods for fisheries research in the Lower Mekong Basin. While these methods can be efficient and cost-effective for obtaining data over large spatial scales, they cannot address all the high-priority uncertainties related to migratory fish. Fisheries-independent studies and technologies like those discussed in this brief should also be implemented to complement fisheries-dependent methods and to answer targeted questions relevant to migratory fish management. Given the complexities of migratory fish ecology, combining multiple tools and techniques is a powerful approach to obtain complementary information or groundtruth results. The suitability of these tools to address high-priority knowledge needs for migratory fishes in Cambodia is further discussed in a publication by Loury et al. (2021).

Tools and Techniques	Benefits	Challenges
Fisheries-dependent Sampling		
Local Ecological Knowledge Interviewing local people about their knowledge of fish populations can provide preliminary insights on fish population trends, migration timing, spawning timing and locations, and habitat use. It is important to recognize that not all individuals will have equally relevant levels of fisheries knowledge. It is advisable to verify species identification and to couple Local Ecological Knowledge surveys with more quantitative approaches.	Low equipment or facilities needs and costs. Few technical skills required.	High time and human resource demands. Variable accuracy of species identification.
Logbooks and Landing Surveys Fish catch monitoring surveys can be used to assess catch status and trends, describe migration timing, infer migration triggers, and describe variation in species diversity and community composition. This can be accomplished through participatory methods, in which fishers record their own catch in logbooks, or through scientists conducting surveys at landing sites. Rigorous training and close oversight are needed to ensure the robustness of participatory data collection. Long-term continuous monitoring programs are valuable for generating trends in fish catch and composition.	Low equipment or facilities needs and costs. Moderate level of technical skills required.	Very high time and human resource demands. Moderate accuracy of species identification.

Tools and Techniques	Benefits	Challenges
Fisheries-independent Sampling		
Targeted research studies can be used to test specific hypotheses and conduct site-specific assessments, while standardized monitoring over time can be used to detect trends. This approach may involve the use of traditional fishing gear in a standardized way, or the use of other technologies. Fisheries-independent surveys can be used to investigate abundance trends, migration and spawning timing, reproductive success, migratory routes and recruitment, among other topics. Standardized, replicable studies are needed to address specific data gaps and provide comparable data between seasons and years.	High accuracy of species identification. Can be used in experimental design to answer specific hypotheses.	High time and human resource demands. Can be costly to implement. Moderate risk of equipment loss or damage. Specific expertise and equipment required.
Micro- and Macro-Reproductive Studies		
Studies that examine fish gonads are useful to determine reproductive timing, fecundity, and size and age at maturity. Microscopic histological examination of gonadal stages is the most accurate approach to confirm reproductive status, but can be expensive and time consuming. Macroscopic staging based on visual inspection of gonads can be a rapid field-based technique, but can be subjective and inaccurate. Increased application of these methods is warranted to better understand spawning requirements and triggers, to inform stock assessments, and set size restrictions.	Low time and human resource demands. Low risk of field equipment loss or damage.	Moderate equipment costs and facility needs. Specific technical expertise and equipment required.
Captive Studies		
Studying fish under controlled laboratory conditions can be used to understand reproductive biology, environmental habitat requirements, spawning triggers, migration cues, susceptibility to stressors and feeding ecology. To-date, most captive studies in the Mekong Basin have been conducted for aquaculture. It can be challenging to ensure that laboratory generated data are applicable to the field.	Low time and human resource demands. Ability to isolate and test the effect of single variables.	Moderate costs. Equipment intensive, requires specialized facilities. Specific technical expertise required.

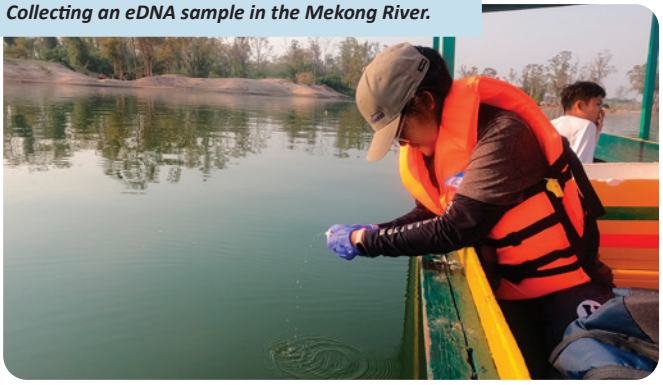
Fisheries scientists labeling tissue collected from Mekong fish.

Tagging a Giant Barb (Catlocarpio siamensis).

Fish diversity sample from Dai Fishery.

Tools and Techniques	Benefits	Challenges
Genetic & Molecular Tools		
Population genetics can be used to determine connectivity between populations and individuals, and can provide information about life cycles and movement patterns. Environmental DNA techniques can be used to measure species diversity, distribution patterns and seasonal movements. Once collected, genetic samples can be used to answer additional questions about species and individual biology.	Low time and human resource demands. No risk of field equipment loss or damage. High accuracy of species identification. Samples can be collected easily and over broad areas.	Requires specialized facilities and technical expertise to analyze data.

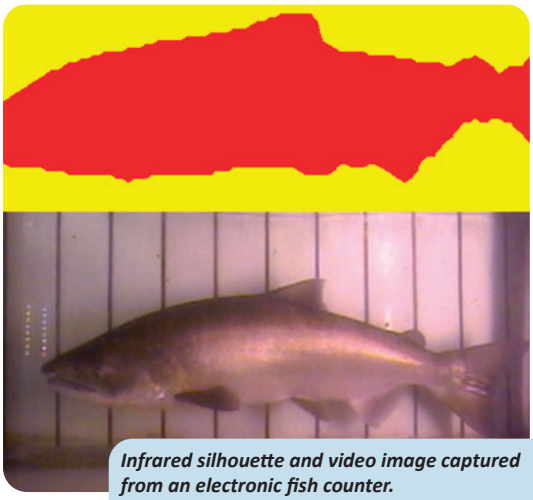
Collecting an eDNA sample in the Mekong River.



Collecting eDNA using a pump and filter system.

Otolith of Jullien's golden carp (Probarbus jullieni).

Tools and Techniques	Benefits	Challenges
Otolith Microchemistry		
Studying the chemical signatures of fish ear bones can be used to study life-cycles and life-histories, such as locating spawning sites and constructing individual fish movements among different habitats to infer migration patterns. This technique requires water chemistry properties to differ among habitats, which must first be verified.	Low time and human resource demands. No risk of field equipment loss or damage High accuracy of species identification. Can provide direct information about individual movement.	Moderate cost. Requires specialized facilities and technical expertise to analyze data. A lethal technique that requires sacrificing fish.
Mark-Recapture and Tagging Tools		
Fish movement can be studied using tools ranging from simple physical tags to sophisticated electronic tracking devices. This is a valuable method for studying migration routes and distances, understanding fish survival, and for identifying key habitats. Electronic tags include acoustic transmitters that actively transmit fish locations to hydrophone receivers, and Passive Integrated Transponder (PIT) tags that transmit fish locations when activated by an antenna or handheld scanner.	Provides empirical data on fish movement. High accuracy of species identification.	High-cost equipment, intensive resource and time demands. High risk of field equipment loss or damage. Specific technical expertise required.

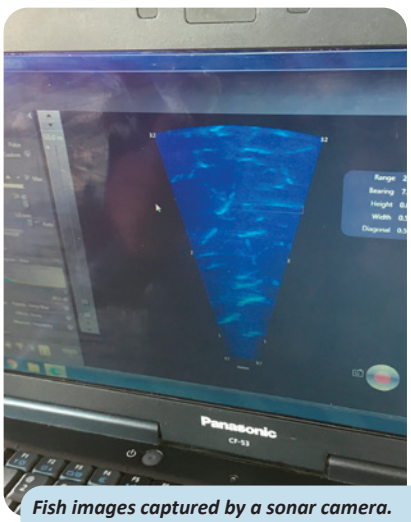


Infrared silhouette and video image captured from an electronic fish counter.

Technicians installing an electronic fish counter on a weir.

Tools and Techniques	Benefits	Challenges
Electronic Fish Counting Systems		
Video systems and infrared scanners can be used to study population trends and passively collect information on migration timing without the need to capture fish. They are most efficient in narrow channels, and are best suited for use in fish passageways or temporary weirs.	Low time and human resource demands. Low costs for ongoing monitoring after initial setup.	High initial equipment cost. Moderate risk of field equipment loss or damage. Specific technical expertise required. Moderate accuracy of species identification.
Hydroacoustic Imaging Technology		
Split-beam hydroacoustic technology can be used to estimate fish biomass, while multibeam hydroacoustic technology can be used to study fish abundance and habitat use, as well as for behavioral observations, fish counts, and measuring fish sizes. These non-invasive technologies can be used in dark or turbid environments.	Low time and human resource demands. Low costs for ongoing monitoring after initial setup.	High initial equipment cost. High risk of field equipment loss or damage. Specific technical expertise required. Low accuracy of species identification.

Deploying a sonar camera in the Mekong River.



Fish images captured by a sonar camera.

Want more information?

For additional details, please refer to the following publication:

Loury, E.K., V.L. Elliott, S.M. Ainsley, I.G. Baird, L.J. Baumgartner, S. Chhuoy, D.J. Lee, P.B. Ngor, B. Touch, A.V. Vu, and Z.S. Hogan. 2021. Priority knowledge needs for management of migratory fish species in Cambodia. Fisheries Management and Ecology. DOI: 10.1111/fme.12483