MEKONG FISH Catch and Culture
ISSN 0859-290X, Vol. 7, No. 3 - March 2002
MEKONG FISHERIES NETWORK NEWSLETTER

Facilitating learning: Experiences with Reservoir Fisheries Joint User/Government Officers Workshops

After making "adaptive learning" an important issue in its training in participatory fisheries management on the regional level, the Management of Reservoir Fisheries (MRF II) is aiming at introducing and implementing "adaptive learning" for actual (co-)managers at reservoirs, that is local users AND line agency staff.

How to introduce and practice "adaptive learning" at the local level?

Major lessons learned from MRF's 1st Regional Training Course on Co-management in Inland Fisheries have been that knowledge is created by interacting and communicating among the Component as well as with those who hold knowledge within local communities and fisheries line agencies". And, that facilitation is the overwhelming issue when strengthening co-management in fisheries, including facilitation of learning.

While the WHAT and WHY of learning-by-doing, adaptive management and process-orientation were easily agreed upon in the above mentioned training course, and indeed have become buzz-words in the MRC's Fisheries Programme ever since, the question remained of HOW to introduce and implement this learning approach at the local level.

Based on principles of adult learning

In order to address this question, MRF II has started to conduct a special type of event for and by co-managers involved in a particular (technical) management issue, called a "Joint User/Government Officer (or JUGO-) Workshop". In developing this form, MRF II based itself on some characteristics of adult learning, such as: adults come to new experiences knowing a great deal; they learn best by building upon their own experiences; they learn more by doing than by listening; they learn best when they are engaged and assisted; they need opportunities to experience, reflect, discover and apply. In short: Not training, but learning is important, and it is learning from each other!

A four-step JUGO process

Workshop structure consists of four sequential, but interrelated steps:

1. co-management teams (of users and Government staff concerned) prepare a proposal for action based on perceptions of problems and needs and local experiences on how to tackle these at the reservoir level; this proposal is presented and discussed, and it is the starting point of the workshop;

2. in order to develop the proposal further, specialists are invited to add technical information and expertise, and most important;

3. existing examples are visited were users "have done it", and opinions on "real life" experiences are exchanged; and

4. when co-management teams finalise their proposals on the basis of what has been presented, heard and seen.

Outside the workshop proper, the proposal will be taken back to the respective reservoir communities where the decision to implement or not to implement the proposals will have to be made.

Conservation Zones in Thailand and the Lao PDR
The first two JUGO-Workshops were held in Sakhon Nakhon, Thailand, and Thalat, Lao PDR, in September and November 2001, respectively. Incidentally, the topic was the same: In practically all reservoir management plans which have been formulated by reservoir users in these countries lately, the creation of conservation zones (CZs) rank very highly. However, it seems that few have sufficient experience on how to set them up, rationale why to set them up and what the results may be. The JUGO-Workshops provided an opportunity to clarify all this. The immediate reaction by the co-managers confirmed the suitability of the process applied. Comments made by participants emphasized the value of learning from experience, improved communication between users and Government staff, fishers' sense of responsibility for resource conservation, and a growing confidence by villagers to actually become involved in the decision on and implementation of management measures. It was decided to organise CZs in three out of four reservoirs under the MRF II in Thailand. Following this, one CZ was actually set up at Huay Luang reservoir in December 2001. In the Lao PDR, recommendations were elaborated to establish seasonal and/or permanent CZs at all five reservoirs. The physical demarcation of permanent CZs in Vientiane at Nam Houm and Nam Suang is underway.

Future workshops
Future workshops are presently prepared for such "hard" issues as cage-culture (Lao PDR) and stocking (Lao PDR, Thailand). Apart from these more technical aspects, "soft" topics such as management planning and facilitation will be dealt with in JUGO-workshops in the coming months, and not only in the Lao PDR and Thailand, but in Cambodia and Viet Nam as well.

Perceptions of Cambodian Fishers about Community Fisheries

This case study was undertaken primarily by interviewing local fishermen in fishing lots #3 and #6 of Siem Reap Province and fishing lots #3 and #5 of Battambang Province and partly by consulting with provincial fisheries staff, FAO Siem Reap Project Staff and Leucaena Project Staff in order to understand the current perceptions of local fishermen about community fisheries or co-management of fisheries.

Cambodia is rich with natural resources, among which freshwater fisheries are one of the main resources providing food security and income to the Cambodian people. Cambodia ranks fourth among the world's top freshwater capture fisheries (Degen et al., 2000). This production comes from the exploitation of large-scale fisheries [fishing lots and bagnets], middle-scale fisheries, family/small-scale fisheries and rice field fisheries.

Generally, inland fisheries resource management has been influenced and determined by the different political and management regimes of Cambodia's past and present. Each management system has had both good and negative implications on fishers' livelihoods and the status of fisheries resources. Since the Khmer Rouge regime (1975-79) to the present, fisheries resources have been managed and exploited in different ways. These can be summarised as follows:

1979- 82: public fishing areas
1982-89: solidarity groups (Krom Samaki)
1989- 98: fishing lot auction

1998-2000: fishing lot with total sub-leasing and research
2001: reform of fisheries management systems

Fisheries Reform

Gum (2000) has documented reliable information on the general issues during the period of 1998-2000. The main issues include:

Focus on revenue collection from the fishing lots rather than sustainable fisheries resource management or equitable rural development;

- Conflicts between conservation and conversion of inundated forests for agricultural lands;

- Growing numbers of short-term benefit seekers (local and external people and fishermen, military and police);

- Tensions and conflicts between local people and lot owners over the resource use; and

- Sub-lease of the total lot areas to private interests for exclusive exploitation.

These issues exacerbated the pressure of fisheries resource use among different stakeholders. Lot owners hired military or armed guards to threaten, intimidate, fine and detain local fishers who fished in or disrupted the fishing lot areas. In some provinces, fishermen had to pay fishing fees to lot owners to fish in the areas.

Outside of the lots, groups such as the militia, police and local authorities occupied the public fishing areas and forced local fishers to pay for their use. These strong pressures produced growing conflicts between lot owners and local fishers during 1998-2000. Degen (2000) reported that in five selected provinces there was at least a 200% increase in complaints from the year 1998 to 1999 (1998, 168 complaints / 1999, 356 complaints). In fact, the figures are probably higher.

Similarly, there were protests in front of National Assembly for several weeks in December 1999 by fishermen from Kampong Chhnang and Kampong Thom provinces . In January-February 2000 they protested the loss of customary access rights to their public fishing grounds.

In consideration of how the above issues were affecting the poor people's livelihood, the government was prompted to quickly implement reforms to fisheries management. The reform entails the reshuffle of the high level administration of the Fisheries Department and the transitional withdrawal of provincial fisheries inspection stations in all fishing lots throughout the country. Moreover, the request of local fishers to reclaim their territory for public fishing areas was partly met by returning parts or the whole fishing lots to the local communities.

Access to Fishing areas

The result of a participatory rural appraisals (PRA) with some fishers in fishing lots # 3 and 6 of Siem Reap Province indicate that local people are very happy with their victory. They are now able to access fishing areas without paying fees to lot owners or powerful groups.

With the announcement by Prime Minister Hun Sen to withdraw all levels of fisheries inspection stations, fishers perceived that they have exclusive rights to do fishing. Rich and opportunistic fishers grabbed the opportunity to do anarchic fishing, using illegal and modern fishing methods such as electrocution, push-net, long trawlers and long bamboo trap fences. Even pumping water bodies around the Tonle Sap were commonplace. There is concern

about future fishery resources for the next generation, as the current destructive and modern fishing methods employed by rich fishermen and illegal fishers are damaging the fish stock.

Such over-fishing and use of illegal fishing methods will cause great depletion of broodstock and damage the aquatic food chain of fisheries resources. It is expected that in the next 2-3 years, the quantity of fish catches will decline dramatically due to the vast shortage of stock replenishment. This situation is faithful to Hardin's prediction of the consequence of open access, in which Baden and Noonan (1998) stated: "Depletion occurred rapidly, before countervailing institutional arrangements or changing cultural values could prevent it".

According to the Government policy statement, one of the main objectives of fisheries reform is to improve food security and reduce poverty of local fishers dependent on fisheries resources. At the beginning, people hailed this objective. However, livelihood improvement and poverty reduction through this fisheries reform may not be achieved. This is because of a number of reasons:

- The poor do not have sufficient monetary capital to purchase modern fishing equipment that can be used to catch more fish;

- At times the equipment of the poor fishermen such as netting, long lining and so forth is damaged by the trawlers used by affluent fishermen; and

- Wealthy fishermen are grabbing the opportunity to intensify fishing exploitation by buying new equipment and increasing fishing effort to catch more fish and earn more profits.

Hence, there would be an increasing gap between the rich and the poor.

Community Co-Management

Having seen these issues it raises the question of how local communities can manage, exploit and conserve fisheries resources sustainably. The concept of **community co-management** of fisheries has been introduced as a way of achieving this objective. Although some community co-management of fisheries has been introduced and implemented in various local communities (CAA in the upstream Mekong River, FAO in Tonle Sap, Siem Reap and Wetland International with Ministry of Environment at Ream National Park), information about community co-management of fisheries has not been well disseminated to all the fisheries stakeholders. As a result, not only simple fishermen, but also technical institutions are wondering what exactly does community fisheries mean and how to implement it.

Preliminary investigation to understand the perceptions of local fishers about community fisheries reveals the following:

- Confusion between solidarity/ collective groups and community co-management of fisheries;

- Obsolete fisheries laws; and

- Implications of social change.

Kalyan et al. (2001) documented three different ecosystems: namely, upland-dependent shifting agriculture, Tonle Sap lowland and coastal areas. Within these areas the terms of community fisheries, community forestry and participatory management of protected areas are used to describe various forms of co-management.

The translation of community fisheries in the Khmer language is sahakum nesaat. This may confuse readers, as it describes a situation in which only the local community owns and manages the fisheries resources in a particular area. In fact, the community is regarded as only one key stakeholder joining with other stakeholders. As well, the Government has a responsibility for the sustainable use and management of fisheries resources.

Community co-management of fisheries translates in Khmer as sorhakrubkrang nesaat daiymean kachoul rum pi sorhakum. This translation indicates that it is a kind of power sharing and participatory management among different stakeholders. Hence the term, community co-management of fisheries should be used in order to avoid confusion later on.

For example, the structure and regulations of the community fisheries is not totally created and decided upon by the fisheries management committee of the community. Instead, there are various degrees of power-sharing arrangements between government and communities. These arrangements fall within the criteria of co-management. Figure 1 shows different kinds of state management, co-management and community management.

Implications of Social Changes in Cambodia

Access to the global community and materialism such as TV, Video and so on has caused an increase in the people's ambition to be rich. Before, there was not such a strong desire for material wealth.

In the fishing lots where there are quite a number of prosperous fishermen, it is always difficult to start the process smoothly as the rich fishermen are against a management system that calls for equity. For example, in fishing lot # 3 of Battambang Province, wealthy fishermen have spoken out against community co-management of fisheries.

Lessons Learned

Cambodian freshwater fisheries are of significant importance to the livelihood of people in the country. The past management systems of fisheries focussed on commercial fishing lots auctions, produced negative impacts on fisheries-dependent households. This prompted the reform of the fisheries sector by the top management with the aim of giving customary fishing rights back to local fishing communities. However, this has resulted in anarchic illegal fishing and over-fishing of fisheries resources around Tonle Sap areas during the transitional period while the community fisheries is not organised and in place.

Having recognised these issues, attention is being made to focus on community fisheries cum co-management, which is regarded as an alternative to achieve sustainable and equitable use and management of fisheries resources. However, this concept of co-management of fisheries is very new to the Cambodian context. People have not yet understood and realized that it is most appropriate to their situation. Other than its newness, another reason for its poor acceptance is that the dissemination process and training of both extensionists and local people is only beginning. Some people still perceive fisheries co-management as a disadvantage to their occupation as they (correctly) believe that when there is fisheries co-management they will have to abide by the regulations and statutes of the community fisheries. Others have thought that fisheries co-management statutes will allow them to do only small-scale family fishing.

Recommendations

Some recommendations to consider include:

- Articulate a sub-degree on community fisheries and update the fisheries laws to meet the current situation facing local communities. Moreover, they should be put into effect soon in order to safeguard and assure legal rights (legitimacy) and responsibilities of local fishing communities.

- Transparency and accountability should be built into the processes of community fisheries/fisheries co-management to avoid the past negative image of community fisheries.

- Resources, including human resources, and financial support should be allocated by the Government (Ministry of Economics and Finance) and NGOs in order to stipulate the processes of community fisheries establishment and implementation.

- Institutional analysis and arrangement for community fisheries should be studied in order to suit changes in the fisheries reforms.

- There is considerable need for the processes of dissemination and training of fisheries co-management at the national, provincial and local levels, if we want to sustain our fisheries resources for the next generation. This will require active participation and coordination from all different stakeholders in community.

References

Baden J.A. and Noonan, D.S. (1998). "Managing the Commons". Indiana University Press: Bloomington and Indianapolis;

Degen, P., Van Acker, F., van Zalinge, N., Nao, T., and Deap, L. (2000). "Taken for Granted: Conflicts over Cambodia's Freshwater Fish Resources". Contribution to the 8th IASCP Conference, Bloomington, Indiana, 31 May to 4 June 2000;

Gum, W. (2000). "Inland Aquatic Resources and Livelihoods in Cambodia: A Guide to the Literature, Legislation, Institutional Framework and Recommendations". Oxfam GB and NGO Forum on Cambodia: Phnom Penh;

Hou, K., Srey, M., Thay. S., Prak, M., Chean, T., and Ouk, L. (2001). "Case Study on CBNRM in Cambodia- Lessons Shared". CBNRM/WWF/IDRC/Oxfam: Phnom Penh;

Pomeroy, R.S. and Williams, M.J. (1994). Fisheries Co-management and small-scale fisheries: a policy brief. ICLARM: Manila;

van Zalinge, N., Nao, T., Touch, S.T. and Deap L. (2000). "Where There is Water, There is Fish? Cambodian Fisheries Issues in a Mekong River Basin Perspective" in Common Property in the Mekong: Issues of Sustainability and Subsistence, (2000). ICLARM, Australian Mekong Resource Centre and SIDA.

Successful Fourth Technical Symposium

On an annual basis the MRC Fisheries Programme arranges a Technical Symposium on Fisheries in the Mekong Basin in order to provide a venue for young riparian scientists to present the results of their research in the Mekong Region to a wider audience. The bigger than ever event took place in Phnom Penh during 10-11 December 2001. Over 140 riparians and other scientists joined in the discussions as well as the New Year's Party celebrating the achievements of the past year and the anticipated prospects for the future.

The MRC Fisheries Programme convenes an Annual Technical Symposium to provide a forum where fisheries colleagues in the Mekong Region can discuss their work. The aim of the Technical Symposium is to let young riparian scientists make their first-ever presentation in the English language and using power-point software.

The format for the Fourth Technical Symposium was very different from previous years. For the first day and a half formal presentations were made. A new feature was launched on the afternoon of the second day when a Mini-Workshop on Fish Sanctuaries was arranged. The new format was suggested to facilitate identification of management options for fisheries line agencies.

While most of the presentations under the themes of (1) Fisheries and the environment, (2) Public Participation in fisheries management, and (3) Aquaculture were from within the Fisheries Programme, contributions from external researchers working within the Mekong Region were also welcomed. Along with the presentations, several of the researchers prepared a poster display, another new feature of the Symposium.

Three Major Themes

Fisheries and the Environment: Habitat diversity is a characteristic of the Mekong. This diversity is reflected along the river (from the mountainous tributaries to the flood plains of the Delta) and in time (between wet and dry seasons). Such diversity of habitats allows for the large number of fish species in the Mekong. Maintaining these habitats and the links between them is essential for sustaining fisheries productivity.

For highlights of the presentations, please e-mail: mrcfish@bigpond.com.kh (Mr Niek P. van Zalinge, Management of Freshwater Capture Fisheries of Cambodia Component, Phase II).

Public Participation in Fisheries Management: Fisheries management is changing from the traditional government sponsored rules and enforcement, to a participatory approach where all stakeholders are involved in the development of management and enforcement measures applicable to local situations. Over the last several years there have been efforts in this direction in the Mekong Region. Some topics for this theme included co-management activities in rivers and reservoirs, developing a co-management ethos among fisheries agencies and the public, training experiences and community ownership and enforcement of fisheries management processes.

For further details, e-mail: resfish@laonet.net (Attn: Messrs Wolf Hartmann and Sommano Phounsavath, Management of Reservoir Fisheries in the Mekong Basin Component, Phase II).

Aquaculture: Aquaculture is an important food producing activity in the Mekong Region, particularly in areas remote from the river fishery. Production systems include rice-fish farming, pond culture and cage culture, and both omnivorous and carnivorous fish are grown. Currently, most production is based on exotic species, but some research activities are examining the use of indigenous species to complement or replace the use of exotics. Resources are often shared with the river fishery, for instance broodstock, seed supply, and in some cases food for cultured fish comes from the river fishery. Production from aquaculture throughout the Mekong Basin must increase greatly in the years to come if fish production and consumption are to keep pace with population growth. Recent research, development and extension activities to support this growth were discussed during the Symposium.

For further information, e-mail: aims@ji-net.com (Attn: Dr Niklas Mattson, AIMS Component).

Mini-Workshop on Fish Sanctuaries

The organisers arranged for a **lively Mini-Workshop on Fish Sanctuaries in the Mekong Region** and their significance in fisheries conservation (based on the first two themes). The role of community management in the establishment and operation of fish sanctuaries was highlighted. Open and free discussion on experiences with fish sanctuaries throughout the Basin provided useful background information and led to recommendations for fisheries agencies considering developing additional fish sanctuaries.

It is anticipated that the Fifth Technical Symposium scheduled for December 2002 may be rotated and held in another riparian country. Watch this space for further details. The Technical Symposium on Fisheries in the Mekong Region appears to have become a institution in its own right.

Publication of Symposium Contributions
In addition to the Abstracts of all the presentations made at the earlier Third Technical Symposium, the Fisheries Programme prepared some of the full papers of that Symposium held in December 2000. The revised document is now available upon request from the MRC Secretariat in Phnom Penh, Fisheries Programme Support Office. A nominal fee of US$10 is charged for the handling and postal costs.

The Proceedings of the Fourth Technical Symposium are under preparation and will be available soon as part of the **MRC Technical Reports Series**.

Welcome to New Programme Officer

The MRC Fisheries Programme is pleased to welcome the personable **Dr Nguyen Quoc An** as the new Programme Officer. Dr An joined on 6 December 2001, just in time for the Fourth Technical Symposium and the five Steering Committee Meetings held in a row before the New Year.

Dr An is a Vietnamese national. He earned his PhD in Ichthyology from the Russian Research Institute of Oceanography and Fisheries in Moscow.

Before joining the MRC Secretariat, Dr An worked as the Deputy Director of the Research Institute for Aquaculture No. 3 (RIA-3), Viet Nam. He has been affiliated with the Management of Reservoir Fisheries Component for many years.

Welcome aboard! It is good to have you with us in Phnom Penh, Dr An!

ASEAN-SEAFDEC Conference

The MRC Fisheries Programme was well represented at the jointly organised ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium, "Fish for the People" held in Bangkok during 19-24 November 2001.

The ASEAN-SEAFDEC Conference that was held in collaboration with the Food and Agriculture Organisation of the United Nations and the Thai Department of Fisheries (DOF) as the host country reviewed the present situation, analysed the existing problems and constraints and presented strategies toward a common vision for the management of fisheries in Southeast Asia.

Three Major Goals
The Conference accomplished three major goals:

- Recognition of the importance of sustainable fisheries in food security for the ASEAN region;

- Creation of a cooperative climate where integrated efforts among member countries of ASEAN can better achieve the goals for sustainable fisheries;

- Emphasis on the significance of such efforts in dealing with issues of social development, especially for the poverty stricken and socially disadvantaged.

The Conference brought together not only technical experts, but also policy makers in an unified endeavour to realise sustainable fisheries in Southeast Asia. For example, the session on "**Inland Fisheries Development and Management**" was mainly based on information obtained by the MRC Fisheries Programme. Component Coordinator Niek van Zalinge highlighted the inland fisheries situation in Cambodia and spoke about possible threats to the fisheries in the Mekong Region. An ICLARM panelist presented the results of analysis of "Modelling the Management of Water Flows to Optimise Aquatic Resources Production in the Mekong Basin". This work has been carried out in co-operation with the MRC Fisheries Programme. In the subsequent discussions several questions and comments were raised, including one from FAO on options for future cooperation between FAO and the MRC Fisheries Programme.

Later Dr Nguyen Van Hao of the Rural Extension for Aquaculture Development (READ) Component gave a presentation for the panel on "**Aquaculture for Rural Development**". For the session "**Fisheries Cooperation**", Ms Jeanineke Dahl Kristensen, Programme Manager, presented the MRC Fisheries Policies and the Programme.

Both the ICLARM and the ADB presentations concentrated on freshwater fisheries and made several references to the MRC Fisheries Programme, including articles in Catch and Culture.

ASEAN Exhibition
In conjunction with the Conference, a week-long **ASEAN Millennium Fisheries Exhibition** was organised to provide an opportunity for the technical experts, policy makers and industrialists to meet together. The MRC was among the 50 organisations with booths.

Underwater Biotelemetry to Study Fish Migrations in the Mekong River

Preliminary tests of two biotelemetry systems, radio telemetry and ultrasonic telemetry, indicate that biotelemetry is a viable tool for the study of fish migrations and fish habitat use in the Mekong River Basin. Five types of transmitters (two radio, two ultrasonic, and one combined radio/ultrasonic) and two types of receivers (radio and ultrasonic) were tested. Ultrasonic transmitters outperformed radio transmitters in tests of transmitter range. Signals from ultrasonic transmitters were audible at a distance of over two kilometres whereas the range of radio transmitters varied between 500m and one kilometre. Careful consideration of the study design and methodology (e.g. transmitter type, receiver type, study site, study species and sample size) can optimise the effectiveness of biotelemetry research. Biotelemetry equipment is now available (through the Management of the Freshwater Capture Fisheries of Cambodia Component) for fisheries research.

Underwater Biotelemetry: Useful for the Study of Mekong Fish?
Over the past five years, the study of fish migrations has emerged as a key area of fisheries research in the Mekong River Basin (Baird et al. 2001, Hogan et al. in press, Lenormand 1996, Lieng et al. 1995, Poulsen et al. 2000, Singhanouvong et al. 1996). Many recent studies have focused on the migrations of Mekong species, using a combination of local knowledge and catch data to infer the movements of fish throughout the Basin (Baird op. cit.,

Poulsen op. cit.). As a result of these studies, fisheries experts have begun to describe the patterns of fish movement in the Mekong River Basin. Based on these descriptions of migratory behaviour and habitat use, one option for future research is the direct measurement of these migrations, including species-specific data on fish movements, using underwater biotelemetry.

Underwater biotelemetry provides direct measurement of fish location, movement and habitat use (Winter 1996). Although biotelemetry has not been applied to the study of wild fish migrations in the Mekong River Basin, the technique may prove useful if applied with careful consideration of the study species and objectives. While transmitter range and high cost potentially limit the effectiveness and widespread use of biotelemetry in the Basin, focused use of this technique can yield valuable information on the life history patterns of a variety of migratory Mekong species.

The optimal telemetry system (radio, ultrasonic or satellite) for Mekong research depends on the objectives, project budget, and the environmental conditions of the area of interest. Traditionally, radio telemetry is used in freshwater environments, especially rivers. However, radio telemetry may not be appropriate for the Mekong River, since radio signals attenuate quickly in deep or brackish water. High conductivity also limits the effectiveness of radio transmitters. Ultrasonic telemetry is normally required in environments of high water conductivity or in applications where the typical water depths exceed 12-15 metres. **Combined Acoustic** (ultrasonic)/**Radio Tags (CART)** are hybrid tags that transmit both radio and ultrasonic signals. Theoretically, CART transmitters enable researchers to track fish in a variety of aquatic environments, including deep and shallow water, freshwater, brackish water and even salt water.

Tags and Transmitters

Satellite transmitters (tags that transmit data to a satellite) may be an option for very specialised research, but technological constraints limit their applicability to studies of Mekong species. Two types of tags exist: Pop-up Archival transmitters (PAT) and data storage transmitters. PAT transmitters are designed to track long-distance migration and behaviour of (typically) marine organisms. The PAT transmitter releases from the study animal at a pre-set date. The transmitter then floats to water's surface and transmits the stored data to a satellite. Unfortunately, pop-up satellite transmitters have not been developed for freshwater conditions. To use satellite transmitter technology in freshwater, researchers must use data storage transmitters. Data storage transmitters are similar to PAT transmitters in that they provide direct measurements of geographical position at regular intervals over many months. However, in order to retrieve the information the transmitter must be recovered from the fish. Transmitter recovery normally requires an intensive recapture operation dependent on commercial and recreational catch returns.

Equipment Tested in the Tonle Sap River

The maximum range of radio and ultrasonic transmitters was tested in the Tonle Sap River, Cambodia. Both the maximum distance (metres along the water surface from the transmitter to the receiver) and maximum depth (distance from a submerged transmitter to a receiver at the water surface) were measured. The maximum surface range was measured by positioning the transmitters one metre below the water surface and then monitoring the strength of the radio/ultrasonic signal at successively greater distances from the transmitters. The maximum depth range was measured by positioning the receiver a metre above the water and then monitoring the strength of the radio/ultrasonic signal as the transmitters were lowered to greater and greater depths. Five types of transmitters and two types of receivers were tested.

Results Are Promising....

The maximum range (surface distance) of each of the five transmitters is provided in Table 2 (see next page). The maximum range of the radio transmitters varied between 384m-813m.

The maximum range of the ultrasonic transmitters varied between 1.4km-2.2km. The observed maximum ranges of the radio transmitters were lower than the maximum ranges of ultrasonic transmitters. The signals of two radio transmitters could not be detected from 813m, a distance roughly equal to the width of the narrowest sections of Mekong River during the high water season. The signal of one of the ultrasonic transmitters was detected from a distance of 2.2km.

The maximum depth range (distance underwater) of each of the five transmitters is provided in Table 3. The maximum depth ranges of the radio transmitters varied between 20-24m. The maximum ranges of the ultrasonic transmitters were not tested, because the ultrasonic signal remained strong at a depth of 24m – the maximum depth of the river at the test site. Both the radio and ultrasonic signals remained strong up to a depth of 20m. At depths greater than 20m, the radio signals weakened rapidly, whereas the signals of the ultrasonic transmitters remained very strong.

What's Next? Factors to Consider When Designing a Telemetry Study

The results of these preliminary tests indicate that underwater biotelemetry is a viable tool for the study of fish migrations and habitat use in the Mekong River. While the utility of radio telemetry remains in question, these tests show that ultrasonic telemetry is a sufficiently powerful tool to detect tagged fish, even at distances of over 2km or at depths greater than 24m. Ultrasonic transmitters may enable fisheries researchers to locate and track fish in the deepest pools (some thought to be more than 100m deep) and widest stretches (theoretically any single channel of width not greater than 4.4km) of the Mekong River. Nonetheless, it was noticed that the signal strength of all transmitters varied from day to day and from site to site. Curiously, the transmitter range appeared to be greater in the Tonle Sap River than in the Mekong River. Although the scientists were not able to determine the cause of this variability, stratified water of different temperatures, wave action, boat noise and equipment condition have all been shown to impact signal strength (Winter 1996). Therefore, the transmitter ranges listed in this paper should be considered as the maximum ranges under optimal conditions. The actual range of each transmitter may vary.

Observed signal strength depended not only on system type (radio or ultrasonic) but also on transmitter type. For example, in tests of radio signal range, the Telonics FIS-550 high power radio transmitter outperformed the Lotek MCFT-7E prototype high power radio transmitter and the LOTEK CART 16-3 combined acoustic/radio transmitter. Similarly, in the tests ultrasonic signal range, the LOTEK CART 16-3 combined acoustic/radio transmitter outperformed the Sonotronics DT-97 depth sensing ultrasonic transmitter and the Sonotronics CHP-87-L coded high power sonic tracking tag. As such, the choice of transmitter must be carefully considered, based on study design and species, tracking needs, and budget. In general terms, larger transmitters are more powerful than smaller transmitters, and single transmitter systems are less expensive than combined (CART) systems.

Airplanes Can Track Radio Tagged Fish

The performance of radio transmitters may be improved by increasing the size of the antenna or by lowering the frequency of transmission. The radio transmitters in this study emitted signals in the 148-150 mHz range. Lower frequencies attenuate less when travelling through water. The use of airplanes to track radio tagged fish may also improve the performance of radio telemetry systems in the Mekong River Basin. Winter (1996) reports that airplane monitoring is an excellent way to track highly mobile species. Airplanes cover large areas quickly and provide two to three times greater detection range than boat mounted receivers.

For this test study, uncoded transmitters and a manual receiver were used. Uncoded transmitters and manual receivers are less expensive than coded transmitters and scanning receivers. Typically, uncoded transmitters and manual receivers enable researchers to track

between 20 and 100 fish at one time. Each uncoded transmitter is programmed with a signal of slightly different frequency, thus allowing for the identification of individual fish. However, for studies involving more than about 20 fish, coded transmitters and scanning receivers enable researchers to identify individual fish much more quickly and easily. Instead of using unique frequencies for each transmitter, the coded transmitter system relies on information encoded in the signal to identify the fish. In this way, many fish can be tagged with transmitters emitting signals of the same frequency.

Several Remote Tracking Stations Beneficial

For non-migratory species with small home range size (e.g. fish that never leave the deep pools of the Tonle Sap River) a manual, mobile receiver is adequate. For migratory species, however, several remote-tracking receivers positioned at strategic points along the river will yield better data. A remote receiving station consists of a receiver, a hydrophone, and a small computer. Remote receiving stations automatically record the date, time, and fish identification number as the fish passes the receiving station. This information can then be downloaded onto a laptop computer. The combined use of several remote tracking stations enables fisheries researchers to track the movement of a fish as it moves past each station.

The use of remote tracking stations increases the efficiency and cost effectiveness of telemetry studies. A large investment in several remote stations may yield proportionally more benefit (data) than a small investment in a single manual receiver, since the study of several fish or many species is very difficult using a single, mobile receiver. Moreover, a manual tracking receiver is limited because it is only capable of monitoring one area at a time and only for as long as the researchers remain in the field.

Small sample sizes make it difficult to relocate fish in the field, and so costly field surveys may not yield new information. If, on the other hand, a large number of fish are tagged, the chance of relocating some fish during each survey is increased. A small sample size also limits the validity of population-level inferences about fish behaviour. By increasing the number of fish tagged, multi-species studies are possible as well.

Possible Study Sites

Based on the results of these preliminary tests, study sites appropriate for ultrasonic telemetry include deep pools, narrow and undivided stretches of the Mekong River, its tributaries and specific focal sites such as weirs, dams, important channels (e.g. Hou Sahong, Khone Falls, Lao PDR), spawning grounds, etc. Examples of such sites include the Tonle Sap River, the narrowest sections of the Mekong River below the Khone Falls, the deep pools of the Tonle Sap and Mekong Rivers, the tributaries of the Mekong River in north-east Cambodia (Sekong, Srepok, Sesan), Lao PDR (Nam Ou), and Thailand (Songkhran, Loei, Mun), and most of the Mekong River upstream of Vientiane. For instance, a series of stations placed (1) in the Tonle Sap River, (2) in a narrow stretch of the Mekong River at Kratie, (3) at Stung Treng at the mouth of the Sekong River, and (4) in the Mekong River between Stung Treng and the Khone Falls would provide information about movement out of the Tonle Sap Lake and upstream to the Khone Falls and the tributaries of north-east Cambodia.

Since many species are believed to migrate between the Tonle Sap Lake and upstream habitats, the study of such migrations is critical to measuring this important link between spawning grounds and lowland and flooded habitats. Alternatively, stations could be placed in the Tonle Sap, Bassac and Mekong Rivers at the Quatre Bras area of Phnom Penh in order to monitor the movement of fish in and out of the Great Lake, downstream toward Viet Nam and upstream toward the Lao PDR.

Study sites that might be considered inappropriate for ultrasonic studies include the widest sections of the Mekong River, flooded forest habitats, huge expanses of open water (e.g. the

Tonle Sap Lake), and multi-channel sections of the Mekong (e.g. Siphandone wetlands in southern Lao PDR).

Equipment Available for Local Fisheries Scientists

The equipment described in this article (the Telonics TR-4 biomedical radio receiver 148-152 MHz with a Telonics RA-14K heavy duty antenna, the Sonotronics USR-96 narrow band tracking ultrasonic receiver with a Sonotronics DH-4-10 directional hydrophone, and a Garmin E-trex Venture GPS) is now available for use by local fisheries scientists through the Management of the Freshwater Capture Fisheries of Cambodia Component. Transmitters must be purchased separately.

Summing Up

This study shows that biotelemetry, and especially acoustic biotelemetry, can be used effectively within the Mekong River Basin. Biotelemetry systems provide direct measurements of fish movement and habitat use, thus enabling fisheries researchers to test current ideas on fish migrations, locate

spawning and feeding grounds, and describe important seasonal habitats. In a large, multi-species ecosystem such as the Mekong River, careful study design is critical to the success of telemetry studies.

References and Products

Baird, I.G., Z.S. Hogan, B. Phylaivanh, and P.B. Moyle. 2001. A communal fishery for the migratory catfish Pangasius macronema in the Mekong River. Asian Fisheries Science 14:25-41.

Bookout, T.A.. 1994. Research and Management Techniques for Wildlife and Habitats. 5th Edition. The Wildlife Society, Bethesda, Maryland.

Hogan, Z.S., N. Pengbun, and N. van Zalinge. (in press) Status and conservation of two endangered fish species, the Mekong giant catfish Pangasianodon gigas and the giant carp Catlocarpio siamensis, in Cambodia's Tonle Sap River. The Natural History Bulletin of the Siam Society.
Lenormand, S. 1996. Les Pangasiidae du delta du Mekong (Viet Nam): description preliminaire des pecheries, elements de biologie, et perspectives pour une diversification des elevages. Memoire de Fin d'Etudes, Ecole Nationale Superieure Agronomie de Rennes, Rennes, France.

Lieng, S., C. Yim, and N.P. van Zalinge. 1995. Fisheries in the Tonle Sap River Cambodia: the bagnet fishery. Asian Fisheries Science 8:255-262.

Poulsen, A., J.V. Joergensen, C. Sokheng, C.K. Chhea, S. Viravong, K. Bouakhamvongsa, U. Suntornratana, N. Yoorong, N.T. Tung, and T.Q. Bao. 2000. Fish migrations and spawning habits in the Mekong mainstream – a survey using local knowledge. MRC Fisheries Programme. Assessment of Mekong Fisheries – Fish Migrations and Spawning and Impact of Water Management Component, Vientiene, Lao PDR.

Singhanouvong, D., C. Soulignavoung, K. Vonghachak, B. Saadsy, and T.J. Warren. 1996. The main wet-season migration through Hoo Som Yai. Indigenous Fisheries Development Project Technical Report Number 4.

Winter, J. 1996. Advances in underwater biotelemetry. Pages 555 – 585 in B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Product List and Descriptions, Wildlife Computers, Redmond, WA 98052USA.

Product List, Lotek Wireless Fish and Wildlife Monitoring, Newmarket, Ontario, Canada.

Computer Training at Cai Be Research Center

Although more than half the READ and AIMS (Viet Nam Sub-Component) staff use computers for work activities few have had any formal computer training. This results in inefficiencies, lost data, duplication of files and virus infections amongst a myriad of other problems. To rectify this, a two-day computer-training course was conducted at the Cai Be Research Centre, Tien Giang Province, Viet Nam, for 8 staff of READ, AIMS and the Centre.

Building Up Computer Skills
The two-day course covered an introduction to personal computers (PC), hardware, software, and basic and more advanced functions using the Windows 98Ò operating system. The training was delivered using an LCD projector, recently purchased by the AIMS Component, that was connected to one of several PCs set up for practice sessions. Two machines (tower and slim frame) were opened up, for the participants to see the interior design and how parts are inter-connected and interact.

The trainees were surprised by the abilities of Windows 98Ò and were very keen to practice sending e-mail, to surf the Internet and to use other multimedia functions. The training was responsive to the many questions raised, taking the course far beyond the original session plans. The course finished with participants “cleaning” (reformatting) a PC and then re-installing all the software.

The training will be replicated for READ extensionists at the Tien Giang Provincial Fisheries Extension Centre (PFEC) of the Department of Fisheries and other PFEC staff soon.

The course showed that low-cost, internal training can effectively meet the needs of line agency staff. Mr Trinh Quoc Trong, a READ staff member, designed and delivered the course single-handedly, with the backing of both the READ and AIMS Directorates. Pretty impressive, for someone whose English and computer skills are all self- taught.

Probarbus – A Genus of the Cyprinidae Family

In the first Catch and Culture Supplement (Vol. 3, No. 4, May 1998), the family cyprinidae was covered. This family is represented by more than 200 species in the Mekong Region, which makes it the most diverse fish family of the Basin. It is thus justified to cover some of the many important genera of this family in separate issues of the Catch and Culture Supplements. In this issue, we will discuss the genus Probarbus, which contains some of the most spectacular and highly esteemed species of the cyprinid family.

Taxonomy
As a result of the high species diversity, the cyprinidae family has been divided into numerous taxonomic sub-categories, i.e., sub-families, tribes, sub-tribes and genera. The genus Probarbus thus belongs to the sub-family Cyprininae, the Tribe Cyprinini and the Sub-tribe Tores.

Probarbus is a Southeast Asian genus of large cyprinid fish. A fish of the genus is easily recognisable, also for non-taxonomists, due to its distinct golden colouration with bold, black longitudinal stripes. Other taxonomic characteristics include large pharyngeal teeth in a single row, a red iris and a dorsal fin with one non-serrated spine and 9-branched rays.

Only three species of the genus have been described: the Seven-line barb (Probarbus jullieni), the Thick-lip barb (Probarbus labeamajor) and the Thin-lip barb (Probarbus labeaminor). All occur in the Mekong Basin and the latter two are Mekong endemics. The

genus illustrates that taxonomic research in the Mekong is a relatively recent phenomenon. For more than a century, only one species, Probarbus jullieni, was scientifically described. Then, as recently as 1992, Dr Tyson Roberts revised the genus and described the two additional Mekong endemics, Probarbus labeaminor and Probarbus labeamajor.

The main distinguishing features between the three species are: Probarbus labeamajor has six longitudinal stribes, whereas Probarbus jullieni and Probarbus labeaminor have only five. The stripes of Probarbus labeaminor are weaker and less visible and it has larger scales than the other two species. In addition, Probarbus labeamajor has greatly enlarged lips compared to Probarbus jullieni and Probarbus labeaminor.

Size

Both Probarbus jullieni and Probarbus labeamajor are large fish. The latter has been reported to grow to 150 cm, whereas Probarbus jullieni is slightly smaller. With a maximum length of 70 cm, Probarbus labeaminor is the smallest member of the genus.

Conservation Status

The Seven-line barb, Probarbus jullieni, occurs in the Mekong, Chao Phraya and Meklong Basins of Indochina and Thailand as well as in the Pahang and Perak Basins of Malaysia. With the possible exception of the Mekong Basin, the species has experienced a drastic decline in recent decades. For example, in the Perak Basin it no longer exists because of the construction of a major dam in 1930. The decline has led to the species being listed on IUCN's list of endangered animals and it is also listed in Appendix 1 of the Convention on the International Trade in Endangered Species (CITES). The Mekong River appears to still sustain many healthy populations of Probarbus jullieni, possibly because this river has so far been less effected by human impacts such as damming and pollution.

In the Mekong Basin, Probarbus jullieni and Probarbus labeamajor are the most common species, whereas Probarbus labeaminor is extremely rare. The latter species is only known from a small section of the middle Mekong around Mukhdahan down to the mouth of the Mun River.

Migration and Spawning

The biology of the genus is very interesting and includes spectacular migration and spawning behaviour. Several spawning grounds for Probarbus jullieni have been identified throughout the Basin, from the Ou River in northern Laos to the Sekong River in northern Cambodia. This species is one of only a few species in the Mekong Basin that spawns during the dry season, from December to February. Its very visible spawning behavioor is well-known among fishers of the Basin and has been described by Mr Sintavong Viravong in his MSc thesis (1996), based on studies in the Ou River, northern Laos. He described how ripe Probarbus jullieni migrate to the "display ground" where they gather and, for a number of days, carry out spectacular courtship behaviour which involves jumping above the surface of the water. When ready, the fish migrate in pairs from the display ground to the spawning site a few hundred metres upstream, where spawning then takes place.

Juveniles of up to about 50 cm in length are frequently caught in flood plains both in the middle Mekong (e.g., in flood plain tributaries such as the Sonhgkhram and Hinboun Rivers) and in the lower Mekong and Tonle Sap River catchment.

Exploitation

Probarbus jullieni and Probarbus labeamajor are highly esteemed food fishes and can be considered some of the most popular fish for fisheries in the Mekong River. During their spawning migration from December to February, they are targeted by gill-net fishers along large stretches of the Mekong and some of its major tributaries. The best documented Probarbus fishery occurs near the Khone Falls, where it constitutes one of the most important fisheries during the dry season. Owing to their high market price, Probarbus from

this site are traded all the way to Vientiane. At the main fish market there, Probarbus are transported by truck every morning from Champassack and sold at 25,000 kip per kilo, corresponding to about US$ 3.5 (based on a visit to the market on 16 January 2002).

Because of their high price, spectacular spawning migrations and visible spawning behaviour, Probarbus species are vulnerable to over-exploitation. However, as mentioned above, the Mekong River still appears to be able to sustain healthy populations of both Probarbus jullieni and Probarbus labeamajor although certain populations may have declined and be threatened by both fisheries and water management activities.

Flagship Species

Owing to their popularity within the Mekong River Basin, the Probarbus species may be ideal as "Mekong flagship species", i.e. a species that can "drive" management efforts because of their public appeal. Managing flagship species will then, in turn, also benefit other species. Probarbus may also be potential "fisheries and environmental indicator species" due to their apparent sensitivity to fishing pressure and habitat alterations.

The regional Technical Advisory Body (TAB) of the MRC Fisheries Programme has selected Probarbus jullieni, together with a few other large Mekong species, as a potential target species for future management strategies for Mekong fisheries. So we will undoubtedly see more of these spectacular species in future issues of Catch and Culture.