Collection of small-scale artisanal fisheries data using interviews of village fishers on the Sre Ambel River, Cambodia

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មូលន័យសង្ខេប

ប្រទេសកំពុងអភិវឌ្ឍអាចទទួលផលប្រយោជន៍ពីការរៀបចំឲ្យមានការគ្រប់គ្រងរួមគ្នា (ឧទា៖ សហគមន៍នេសាទ) រវាងទីភ្នាក់ងាររដ្ឋាភិបាល និងអ្នកនេសាទនៅក្នុងតំបន់ ពីព្រោះអ្នកនេសាទគឺជាធនធានមនុស្ស និងសង្គមយ៉ាងសំខាន់សម្រាប់គ្រប់គ្រងធនធានប្រកបដោយប្រសិទ្ធភាព និងការពង្រឹងច្បាប់នេសាទ ក៏ដូចជាចំណេះដឹងអេកូឡូស៊ី និងភាពសម្បូរនៃត្រី និងជលផល។ ទោះជាយ៉ាងណា ការខ្វះព័ត៌មានពីវិសាលភាព និងបញ្ហាជុំវិញការនេសាទអាចរារាំងដល់ការបង្កើតកិច្ចព្រមព្រៀងដែលមានប្រសិទ្ធភាពរវាងសហគមន៍ក្នុងតំបន់ និងទីភ្នាក់ងាររដ្ឋាភិបាល។ ដើម្បីដោះស្រាយគម្លាតព័ត៌មាននៅក្នុងសហគមន៍នេសាទទន្លេដែលបានស្នើនៅក្នុងប្រទេសកម្ពុជាយើងបានប្រើវិធីសាស្ត្រសម្ភាសន៍បែបពាក់កណ្តាលទម្រង់(semi-structured interview) ដែលតម្រូវឲ្យមានការប្រជុំជាសាធារណៈជាមួយនឹងភូមិចំនួន០៦ នៅក្នុងឃុត្តាធិការជលផលនៃប្រព័ន្ធស្ទឹងស្រែអំបិល។ គោលបំណងរបស់យើងគឺ ១) កំណត់ថា តើវិធីសាស្ត្រសម្ភាសន៍បែបពាក់កណ្តាលទម្រង់ផ្តល់ទិន្នន័យជលផលដែលមានសារៈប្រយោជន៍ឬទេ ២) ប្រើទិន្នន័យទាំងនេះដើម្បីផ្តល់យោបល់ដល់អ្នកពាក់ព័ន្ធ សម្រាប់ការអភិវឌ្ឍន៍សហគមន៍នេសាទ។ វិធីសាស្ត្ររបស់យើងបានផ្តល់ទិន្នន័យអំពីប្រជាសាស្ត្រក្នុងតំបន់ និងតួនាទីរបស់យេនឌ័រ(gender roles) គឺអំពីលក្ខណៈសំខាន់ៗនៃនេសាទនិងបច្ចេកទេស និងសក្តានុពលសម្រាប់ការអភិវឌ្ឍវារីវប្បកម្ម និងបានជួយកំណត់បញ្ហាប្រឈមដែលត្រូវដោះស្រាយ។ ត្រី៨៣ប្រភេទ និងភាវរស់ទឹក២០ប្រភេទផ្សេងទៀតត្រូវបានកំណត់អត្តសញ្ញាណថាមានសារៈសំខាន់ខ្លាំងសម្រាប់ការគ្រប់គ្រងនៅក្នុងប្រព័ន្ធស្ទឹងស្រែអំបិល។ បច្ចេកទេសនេសាទរួមមាន ឧបករណ៍នេសាទច្រើនបែប ហើយឧបករណ៍ទាំងនេះ និងកន្លែងនេសាទមានការប្រែប្រួលតាមរដូវ។ ទាំងបុរស និងស្ត្រីបានចូលរួមនេសាទ ហើយជាញឹកញាប់មានតួនាទីបំពេញគ្នាទៅវិញទៅមក។ ឧបសគ្គចម្បងៗដែលបានកំណត់សម្គាល់រួមមាន ការផ្លាស់ប្តូរជម្រក សំពាធនេសាទ និងកង្វះបទបញ្ជា។ វារីវប្បកម្មត្រូវបានកំណត់ថាជាជំណោះស្រាយដែលអាចទៅរួចចំពោះបញ្ហាប្រឈមមួយចំនួន ប៉ុន្តែវាអាស្រ័យទៅលើការប្រើប្រាស់ដី និងទាមទារការគាំទ្រ។ ដោយដែនកំណត់របស់វាត្រូវបានដឹង វិធីសាស្ត្រសម្ភាសន៍បែបពាក់កណ្តាលទម្រង់របស់យើងអាចដើរតួជាគំរូសម្រាប់ការប្រមូលទិន្នន័យ(user-based data) នៅទីជលផលដាច់ស្រយាលផ្សេងទៀត ដែលធនធានចាំបាច់សម្រាប់ប្រមូលទិន្នន័យមិនពាក់ព័ន្ធនឹងជលផល (fishery-independent data) នៅមានកម្រិត។

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Abstract

Developing countries can benefit from co-management arrangements (i.e., community fisheries) between government agencies and local fishers because the latter can provide social and human capital critical for effective resource management and enforcement of fishing regulations, as well as knowledge on the ecology and relative abundance of fish and fisheries. However, limited information on the scope and issues surrounding fisheries can impede establishment of effective agreements between local communities and government agencies. To address this information gap in a proposed community river fishery in Cambodia, we used a semi-structured interview approach which employed public meetings with six villages within the fisheries jurisdiction of the Sre Ambel River system. Our objectives were to 1) determine if semi-structured interviews could generate useful fishery data, and 2) use these data to make recommendations to stakeholders for development of a community fishery. Our approach provided data on local demographics and gender roles, important fishery characteristics and techniques and potential for aquaculture development and also helped identify challenges to be addressed. Eighty-three fish species and 20 aquatic non-fish species were identified as being of potentially high management importance in the Sre Ambel River system. Fishery techniques included diverse types of gear and these and the areas fished varied seasonally. Men and women were both involved in fishing, often in complementary roles. Potential challenges identified included habitat alteration, fishing pressure and lack of regulation. Aquaculture was identified as a possible solution to some of the challenges, but would depend upon land use and require support. Provided its limitations are understood, our semi-structured interview approach may serve as a model for collecting user-based data in other isolated fisheries where the resources needed to collect fishery-independent data are limited.

Keywords

Artisanal, Cambodia, co-management, community fishery, semi-structured interview.

Introduction

Limited availability of information impedes successful management of small-scale fisheries in developing countries. Sound fisheries management depends on accurate information about a fishery, yet management agencies in such countries often suffer from limited human and financial resources for data collection and law enforcement (e.g., Eggert & Greaker, 2009). Absence of coherent, reliable and accessible information on important fish species and fisheries hinders formulation of relevant policies and fishery regulations (e.g., Moffitt *et al*., 2010). As a consequence, small but locally important fisheries receive less government attention in terms of fisheries management and enforcement of existing fisheries laws and regulations (Eggert & Greaker, 2009).

Fisheries in Southeast Asia have experienced declining yields and increasing conflicts which are attributed in large part to habitat alteration (Garces *et al*., 2008; Ngor *et al*., 2018) and increasing fishing pressure (Salayo *et al*., 2006). This is especially true for fisheries in smaller freshwater rivers, which are regionally important yet typically overlooked by management agencies due to limited resources (Hortle, 2007; FAO, 2010, 2012; Welcomme *et al*., 2010; Bartley *et al*., 2015). As a result, local fishing communities and government agencies have sought to establish community fisheries where fishing communities and government agencies share management responsibility and where fishing communities play a significant role in establishing fishing regulations and ensuring adherence to these (Almeida *et al*., 2009). Community fisheries can benefit conservation because local fishers can provide the social and human capital critical for effective fisheries management and law enforcement (Castello *et al*., 2009), as well as valuable knowledge on the biology and ecology of fish and fisheries (e.g., Haggan *et al*., 2007; Moreno, 2007). This facilitates establishment of management approaches that are more culturally and ecologically relevant and may result in greater compliance (King & Faasili, 1999; Crawford *et al*., 2004).

Community fisheries are widely seen as key to improving fisheries management and reducing overexploitation (Sen & Nielsen, 1996; Pomeroy & Berkes, 1997) and hundreds have been established worldwide, primarily in marine environments (Levine & Richmond, 2014). Community fisheries also have been successfully implemented in larger river systems and floodplain lakes (e.g., Armitage *et al*., 2008; Almeida *et al*., 2009), including the Mekong River and Tonle Sap Region in Cambodia (Ratner, 2006; Resurreccion, 2006; Nuon & Gallardo, 2011). Developing an effective community fishery requires establishment of a co-management plan that outlines the goals, responsibilities, cultures, issues,

strategies, regulations, and other key components of the agreement (Pomeroy & Rivera-Guieb, 2006). This is particularly difficult in smaller systems where fisheries data have not been compiled and adequate funding and personnel are not available to collect necessary information using traditional sampling.

An alternative to traditional methods for collecting quantitative fisheries information is to collect it directly and qualitatively from the fishers themselves. In systems where routine empirical sampling is not feasible, local fishers are often the most knowledgeable about a fishery and its issues (Haggan *et al*., 2007; Moreno, 2007). The semi-structured interview approach is a powerful tool for obtaining qualitative data directly from people (Rogers, 2001). Semi-structured interviews entail a formal interview where the interviewer uses an interview guide that lists questions and topics to be covered during the conversation, usually in a particular order. It varies from a structured interview in that an interviewer can follow topical trajectories in the conversation that may stray from the guide when deemed appropriate (Rubinson & Asnis, 1989). Although the approach is commonly used in the medical and linguistics fields (e.g., Patton, 1999; Ho, 2006; Alshenqeeti, 2014; Leung, 2015), it is much less common in fisheries management (McGoodwin, 2001).

We used a semi-structured interview approach to address information gaps in a proposed community fishery in Cambodia. Public meetings with villages from within the community fishery jurisdiction were conducted to collect basic data directly from the fishers (user-based approach). Our case study addressed two objectives: 1) To determine if semi-structured interviews in fishing villages could be used to collect basic data on the Sre Ambel River fishery, and 2) To use these data to provide recommendations to stakeholder groups to aid in the development of a community fishery. This approach may have merit as a model for employing a user-based approach for collecting basic fisheries data in other isolated fisheries where the infrastructure to collect fishery-independent data is unavailable.

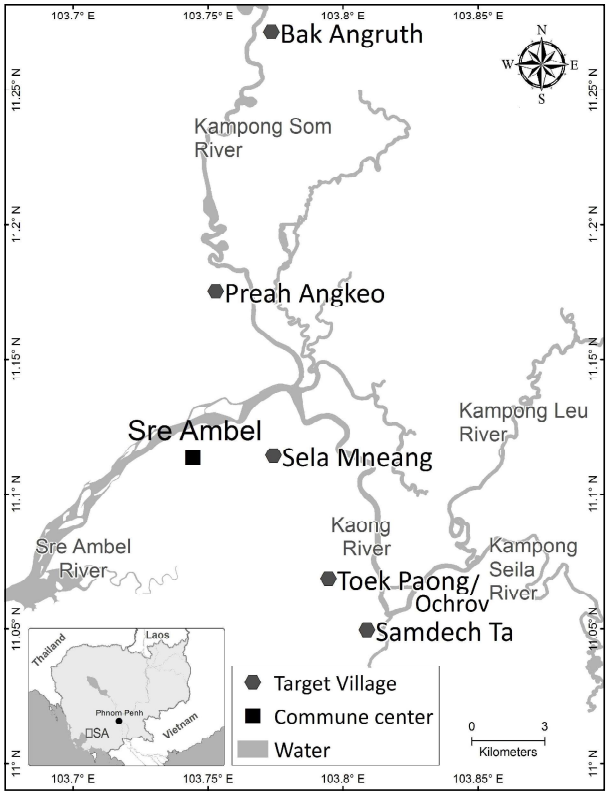

Fig. 1 The Sre Ambel River system in southern Cambodia.

Fig. 2 Sre Ambel River.

Methods

Study area

The Sre Ambel River system is a complex matrix of lowland rivers and backwaters, flooded forests, and agriculture in Koh Kong Province, Cambodia (Figs 1–2). The river generally flows towards the southwest before emptying into the Gulf of Thailand, with tributaries originating in the Elephant Mountains to the east and foothills of the Cardamom Mountains to the west. At least ten rural villages depend on its fisheries for a substantial portion of their sustenance, livelihoods and cultural continuity. The Fisheries Administration (part of the Royal Government of Cambodia's Ministry of Agriculture, Forestry and Fisheries) has been working with the Wildlife Conservation Society (WCS) and the U.S. Forest Service (USFS) to establish a community fishery with the

Sre Ambel River fishing villages. Under this arrangement, a management board composed of village representatives can provide input into fisheries management, regulations and law enforcement.

Stakeholder meetings

Personnel from WCS arranged meetings with six of ten identified villages along the Sre Ambel River system from 7 June to 10 June 2018. Village leaders invited their citizens with an interest in the fishery. Attendance was voluntary, and no *a priori* attendance targets were established. All meetings occurred in community centres located in or adjacent to villages. Individual meetings were held with the villages of Bak Angruth, Preah Angkeo, Sela Mneang and Samdech Ta, and a joint meeting was held with the villages of Toek Paong and Ochrov due to their proximity. These six villages were selected by WCS and were assumed to represent all communities in the Sre Ambel River fishery as we could not visit all ten villages in the timeframe available. Each meeting included the village chief, representatives of families associated with fishing, representation from the Fisheries Administration (two individuals including the Interim Community Fisheries Department Director), and representatives from WCS (up to four individuals), USFS (one individual), and Mississippi State University (two individuals, MSU).

Four main categories of information were targeted for collection during stakeholder meetings. These included data on demographics and gender roles, capture fishery characteristics (i.e., who, what, when, where, why, and how) and issues, aquaculture potential and assistance needs. Meetings were initiated by the Fisheries Administration who explained of the importance of developing the community fishery partnership and requested participants to share freely their opinions and concerns. After introductions and general instructions, community members were asked to identify fish and aquatic fauna that they capture or otherwise use via colour pictures on a series of posters displaying the aquatic species of Cambodia. The posters included 532 fish species (freshwater, brackish, and marine) and 57 aquatic non-fish species (i.e., crustaceans, molluscs, reptiles, mammals) potentially inhabiting the region. Species identification was led by WCS staff members (one per group) who had existing relationships with community leaders and were fluent in the native language, Khmer. Villagers were divided into two groups to review the posters, which reduced the number of images reviewed by each group by half. In each instance, the group leader would point to an image and village citizens would reach consensus on whether the species was collected in the fishery. This helped reduce misidentification of species and temper avidity of individual fishers who claimed more species than others in their village. This process lasted about one hour. Concurrent to this activity, demographic information on participants were recorded and the village chief provided village-wide demographic data.

Following species identification, participants were interviewed as a group using a semi-structured interview approach following a series of questions developed *a priori* (Appendix 1). In a semi-structured approach, the questions are predetermined but the order and wording can be modified based on the interviewer's perception of what seems most appropriate (Galletta, 2013). Our questions focused on several themes, including fishing techniques, purpose of fishing, distance to fishing areas, times of year when fishing occurs, issues or challenges related to the fishery, possible actions or regulations that could be implemented, aquaculture, fish use and processing, gender roles in fishing, technical expertise desired and funding needs. MSU staff posed the questions and WCS staff provided translations between English and Khmer. Participants were also given the opportunity to provide unsolicited input and then the meeting was adjourned.

Data management

A common meeting was arranged for the villages of Toek Paong and Ochrov due to proximity. Logistical concerns required that the villages jointly participate in fish identification; thus, the total number of fish identification sessions was five. However, these villages were interviewed separately to provide greater data resolution, yielding six semi-structured interview sessions.

Information collected was entered into Microsoft Excel, where data were synthesized into frequencies of responses from villages. Species of fish from posters were verified for family, genus, species and common names using www.fishbase.org, whereas other aquatic species from posters were verified using www.gbif.org. To determine species most often collected by village fishers and in need of further research and management, each species was ranked by the number of villages identifying it as being collected or otherwise part of their fishery. Species with no villages or only one out of five villages (≤20%) identifying it as collected were considered of low research and management need (low importance), at least in the context of the fishery. These are species which are likely uncommon in the fishery or potentially misidentified. Species identified by two or three villages (40–60%) were considered of medium research and management need (medium importance) and species identified by four or all five villages (≥80%) were considered of potentially high importance to the fishery and likely represent confirmed, common catches in village fishing activities. Although these species may or may not be important to subsistence or commercial success, they

represent species impacted by fishing activities and in need of management and research attention.

Recommendations

Recommendations for development of a community fishery were derived from the synthesis of data from the villages interviewed. Interviewees were assumed to be representative of the fishery community of each village and providing uninhibited answers, although the information was obtained through language translators and village authorities and a government fisheries official were present during the process. Participation was dependent on community connections that were previously established. To ensure quality of data for making generalizations to the entire fishery community, only repeated, similar answers from multiple villages were considered to be common truths (Yach, 1992). Repeated themes from at least half (≥ 50%) of villages interviewed were distilled into pertinent recommendations. In addition, recommendations also included perspectives important to the success of co-manageed fisheries (e.g., Wilson *et al*., 2003). Recommendations followed data collection categories, namely demographics and gender roles, capture fishery characteristics, aquaculture potential and perceived challenges.

Results

Demographics and gender roles

The six villages interviewed contained from 134 to 510 families with 626 to 2,291 people per village and a total population of 7,231 people. Female and male participants were present at meetings and a total of 48 adult females and 39 adult males attended these (Table 1).

Both men and women were involved in fishing, with men described as leading fishing efforts (i.e., where, when and how to fish) and women supporting fishing by holding boats in place while men fished. Women undertook primary responsibility for sorting, processing and selling fish at market. Older adults described traditional roles of men and women commonly fishing together as couples; however, with declining catch rates in recent years, men were said to go further, fish longer and catch less than in the past, and women assisted with fishing less frequently as a result.

Capture fishery characteristics

Village interviewees indicated that many families were involved in fishing for subsistence or small-scale commercial purposes, although the number of families or percentage of the village community was not reported. In general, people noted trying to capture fish to meet family needs and minimize purchasing fish from markets, or small-scale sale of fish to purchase other cooking ingredients. Commercial fishing was also present in most villages, but meeting participants indicated fewer families participated in commercial fishing than subsistence fishing. Fishing occurred throughout the year, with best fishing generally occurring during low water periods in the dry season or between the wet and dry seasons when fish migrate, but not all fishers fished all year around. Villagers reported that, when not fishing, many farmed fruit and vegetables (indicated by five out of six villages), produced rice (five), collected and sold forest products (three), left the village to work on construction in larger cities (three) or made natural charcoal to sell (one).

Table 1 Demographics of villages and participants of community meetings held in June 2018 in the Sre Ambel River system, Cambodia.

Demographic	Villages						Totals
	Bak Angruth	Preah Angkeo	Toek Paong	Ochrov	Sela Mneang	Samdech Ta	
Number of families	310	510	134	164	375	135	1628
Total people	1,400	2291	672	681	1561	626	7231
Male		1166	324	327	750	292	2859
Female		1125	348	354	811	334	2972
Meeting attendees							
Male	8	4	4	2	5	16	39
Female	18	13	3	7	7	0	48

All six villages fished nearby (<3 km) their villages, and most fished longer distances (>3 km) when necessary. Fishers reported having to travel farther to fish during the dry season than the wet season, and attributed this to increased salinity in the lower river during periods of lower flow. However, catch rates were often greatest during this period for fishers willing to travel because fish tended to concentrate upstream. Fishing areas often overlapped locations of other villages along the river. Fishing gears included passively fished gears (gill nets, bamboo pound nets, trotlines) and actively fished gears (hook and line, fish traps, cast nets, hand trawls, basket nets, gigs/spears; Fig. 3). Use of spears and gigs tended to occur during the dry season when water levels were low and water clearer, making fish more concentrated and visible.

Eighty-three fish species from 24 families were identified by at least 80% of villages. These were designated as being of potentially high importance for the fishery (Appendix 2). Another 141 fish species in 36 families were identified as being of medium importance (Appendix 3). For non-fish aquatic catch, 20 species from 9 families were also determined as being of high importance (Appendix 4). Almost all species captured were utilized as food or sold to live markets in the town of Sre Ambel. In addition to primary river channels and connected backwaters, fishers identified rice fields and floodplain forests as important regions for the fishery. Rice fields and forests composed primarily of the genus *Melaleuca* are inundated during the wet season and provide additional habitat for fish, allowing lateral movement from the river to the floodplain. Flooded forests were identified as being important spawning areas for many fish. Villagers also noted the importance of ponds within the forests for providing habitat for fish during the dry season.

Villages identified what they perceived as the primary issues facing the fishery. All six villages interviewed noted that catch rates were declining due to poor management and irresponsible fishing practices. Two villages described a 50% to 80% decline in catch over the past 15 years, while the remaining four simply stated that catches had declined. Villages placed much of the blame on the use of illegal fishing gears or techniques by outsiders, although other villages and occasionally local fishers from within the village were also blamed. Illegal fishing gears reported included electric fishing, chemical poisoning of fish, use of scare tactics to push fish into traps, and spearfishing at night using lights and underwater breathers during the dry season.

All six villages reported habitat degradation as a serious concern. More specifically, sand mining (indicated by five out of six villages), deforestation (five), and loss of spawning habitat (five) were implicated. Sand is harvested using hydraulic vacuums from sand bars within the river and deposits on inner river bends. Riparian forest is bulldozed to provide access to sand

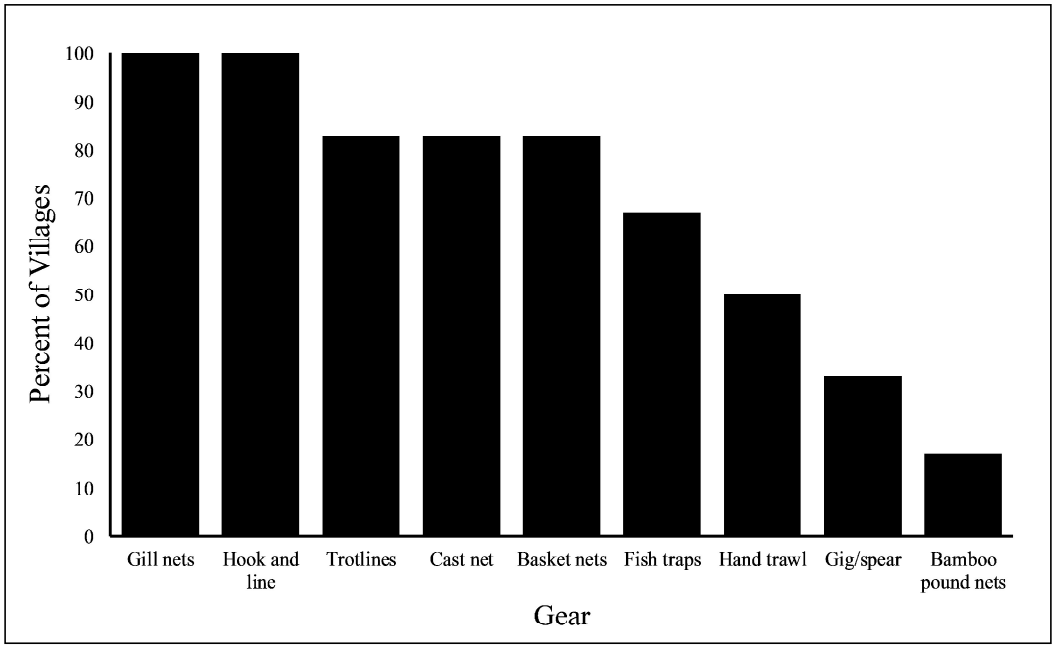

Fig. 3 Passive and active fishing gears used by villages in the Sre Ambel River system.

deposits. This activity is illegal because it is conducted outside of permitted areas and occludes river navigation due to the large hoses laid across the river surface. Sand mining appears to be removing most of available sand bar habitat, which is particularly problematic for conservation of the critically endangered royal turtle *Batagur affinis*. This species is designated as the National Reptile in Cambodia and currently only occurs in the Sre Ambel River system (Seimon *et al*., 2017). Additional impacts include changes in river hydrology, loss of fish habitat, sedimentation, and deteriorating water quality. Similarly, villagers noted that removal of riparian forest habitat for alternative land development and lumber was altering river hydrology and fish spawning.

Several other concerns were reported to a lesser extent. Half of the villages noted that privatization of waterfront property has reduced fishing access and that historic fishing grounds are no longer accessible. This is true for the Sre Ambel River and its tributaries, adjacent floodplain forests and isolated ponds and lakes on newly privatized lands. One village noted concerns with changing climate, whereas one noted increasing human populations in the area and interviewees from Toek Paong village noted that a commercial pig farm had been constructed near the river with little regard to effluent control. Effluent was draining into ponds and the river reach fished by the villagers and had affected drinking water, with increased reports of illness after exposure.

Aquaculture potential

Aquaculture is not commonly practiced by villages in the Sre Ambel River system, although all villages were interested in the potential for adding aquaculture to their livelihoods. Perceived constraints to this included lack of available land, cost to construct ponds, cost and availability of fingerling fish to stock ponds, availability of feed and technical expertise. Some villages included members that had constructed one or more ponds that they stock with small wild fish captured from the river. Fish are raised using offal from harvested chickens and discarded food or termites from the forest. Other villages reported that people had attempted to culture fish such as tilapia *Oreochromis* spp., pangasid catfish *Pangasius* spp. or other species but had either failed or had only temporary success due to lack of technical expertise or problems with flooding and escape of cultured animals.

Species that were identified as being desirable for culture included climbing perch *Anabas testudineus*, snakeheads *Channa* spp., tilapia, catfish *Pangasius* spp. and *Clarias* spp., carp (Cyprindae), eel (family not specified), and in areas with saline waters, barramundi *Lates calcarifer* and mud crabs *Scylla* spp. Ponds were the desired method of aquaculture, as cage culture was not perceived as a good method by several villages in the Sre Ambel River system due to the potential for theft. Villages reported that the primary market is for live fish with little demand for freshly dead whole or cleaned fish. Fish not sold or consumed immediately could be fermented, turned into a fish paste called prahok, dried, or in some instances smoked for long-term storage.

Assistance needs

The six villages interviewed requested technical expertise and strategic funding assistance from WCS, USFS, and MSU personnel. Technical expertise for wild capture fisheries included help with development of a community fishery and information and guidance for developing an ecotourism strategy. All six villages expressed interest in developing ecotourism, including recreational fishing, wildlife viewing, rural cottage rentals and marketing local goods and crafts. Requests for technical expertise for aquaculture included pond design and general husbandry assistance. Two villages also requested technical expertise on vegetable and poultry farming. Funding was requested to help finance pond construction, improve aquaculture fingerling supply and support fishery enforcement, including funds to purchase a boat for enforcement and to hire conservation officers.

Recommendations

Common themes in responses to each data category (i.e., demographics and gender roles, fishery characteristics, aquaculture potential and challenges) were identified from at least half of the villages surveyed. This provided nine recommendations encompassing common themes important to the establishment of the community fishery for the villages surveyed, but also of potential relevance for the application of these techniques elsewhere. The recommendations comprised: 1) Create an inclusive community fishery council, 2) Determine vulnerable river areas in need of protection, 3) Define allowable fishing gears and techniques, 4) Strengthen enforcement capacity, 5) Visually display regulations on the river, 6) Develop plan to protect and restore riparian forests, 7) Establish an enforceable sand mining/resource extraction policy, 8) Implement a standardized evaluation program, 9) Develop an aquaculture outreach programme.

Discussion

Our use of a semi-structured interview approach at community meetings with stakeholders provided valuable and substantial information on the Sre Ambel River fishery. Village fishers provided data on species importance, techniques and gears employed, disposition of catch and identified key issues facing the fishery. These

data will be essential in developing the community fishery and preliminary fishing regulations.

We identified 83 species that were collected by at least 80% of the villages interviewed. These were collected during fishing activities or otherwise used or observed by fishers in each village. These data represent potential species occurrence and suggest that these fish are collected in the fishery and may require management actions for conservation. However, the data do not represent abundance or indicate the importance of a given species to the fishery in the Sre Ambel River system. Further, the data are only as accurate as the villagers' ability to identify fish to the species level (O'Donnell et al., 2012). We employed a group consensus approach, allowing participants to discuss a species among themselves when opinions differed, which should have reduced false positives to some degree. However, future research should include specimen collection and ichthyological expertise to confirm species identifications.

Several species were identified as being particularly important to villagers for consumption and small-scale commercial sale. These included the climbing perch *Anabas testudineus*, several snakehead species (*Channa* spp.), and several catfish species (*Pangasius* spp. and *Clarias* spp.). Prawns *Macrobrachium* spp. were also of particular importance, especially during the wet season in flooded *Melaleuca* forests. Initial management efforts could focus on these species while targeted research identifies additional management needs in the fishery. Fishers expressed concerns with declining catch rates and size for these and other species and suggested that recruitment overfishing may be eliminating fish before they have the opportunity to spawn. Further, loss or degradation of spawning habitat was indicated by all villages interviewed, which is a commonly reported issue in stream fisheries elsewhere (e.g., Goldstein & Meador, 2011; Winemiller *et al*., 2012).

A major concern expressed during interviews was illegal fishing by outsiders. Artisanal and small-scale commercial fisheries in Cambodia and worldwide are under increasing pressure from overfishing (Gordon, 1954; McManus *et al*., 1992; Worm *et al*., 2009), often due to increasing harvest by more sophisticated mobile fishers from outside of the local fishing community (Almeida *et al*., 2009). Artisanal fishers rely on local resources, therefore declining fish harvest can lead to food insecurity, cultural stress and poor economic performance manifested as poverty in their communities (Andrew *et al*., 2007; Bene *et al*., 2007; de Graaf *et al*., 2011). Further, competition for limited resources may put small-scale local fishers in conflict with larger-scale external fishing enterprises (Pauly, 2006) and act as a barrier to economic advancement in local communities.

Despite the value of the semi-structured interview approach for collecting basic information when no data or a mechanism for collecting data are available, several authors have addressed methodological concerns allied to the use of interviews in qualitative social science research (e.g., Potter & Hepburn, 2005; Ho, 2006; Myers & Newman, 2006; Alshenqeeti, 2014). A major challenge with the semi-structured interview is ensuring that data are valid and reliable (e.g., Leung, 2015). Because interviewers can modify questions as a conversation progresses, the interview process is less systemized and standardized than a structured interview, which can increase information variance (Segal & Coolidge, 2003). In other words, it can increase the chances that different interviewers will elicit different information from the same individual or group. To minimize this possibility, we used the same interview team for all village meetings.

Conversely, allowing flexibility in the interview process has been shown to improve rapport between the interviewer and subjects compared to more formal and structured interviews (Rubinson & Asnis, 1989; Rogers, 2001). This flexibility also promotes greater response depth by providing the interviewer with an opportunity to probe and expand on an interviewee's responses (Rubin & Rubin, 2011). At no time during our community meetings was there a sense of tension or distrust between the participants and the interview team. All participants appeared to be excited to share their knowledge. This of course might lead to avidity bias, as individuals attending meetings were the most interested in the state of the Sre Ambel River fishery. However, we were not trying to characterize each village as a whole. We were simply trying to collect basic information on the fishery. In that regard, having the most avid fishers should have ensured that the data collected were more accurate and valid.

Data accuracy and validity can be a concern when it is collected qualitatively via interview (Bernard *et al*., 1984). The quality and credibility of derived data can depend largely on the audience and research purposes (Patton, 1999). Criteria for determining the quality and credibility depend on the purpose and outcomes of the research (Patton 1997); that is, one must weigh the potential benefits of the data against the consequences of being wrong. O'Donnell *et al*. (2012) compared fisher interviews to fisher logbooks and independent landings data and found that interviews should be used cautiously to inform specific catch targets, but also concluded that interviews were a reasonable proxy for more costly research methods. For the Sre Ambel River fishery, we did not estimate specific harvest parameters and the consequences on misidentifying a fish species or overemphasizing a perceived issue are relatively minor given

the need for preliminary data to develop a co-management agreement.

Our consultations with the villages helped us to identify the following preliminary recommendations for development of the co-management agreement. These would not have been possible prior to our study due to limited information on the fishery. We offer for consideration the following nine recommendations, which are similar to co-management challenges in small-scale fisheries elsewhere (Rettig *et al*., 1989; Wilson *et al*., 2003; Salas *et al*., 2007).

1. *Create an inclusive community fishery council*. Representative, knowledgeable and sustainable management is imperative to the success of co-managed and small-scale fisheries (Jentoft *et al*., 2003). It was evident that many villages fished beyond their local reach of river, particularly during the dry season. The co-management agreement will need to create a framework that addresses use of regions by multiple villages. The governing body (council) will require representation of all villages to ensure compliance with agreed fishing regulations.
2. *Determine vulnerable river areas in need of protection*. Areas where fish may be more vulnerable to fishing pressure due to aggregations, spawning and so forth are important to regulate (Jul-Larsen *et al*., 2003). River zonation such as no-take areas may be necessary to protect sensitive areas from overharvest. Village fishers and/or directed research can be used to identify important areas for reproduction, staging, migration corridors or other life history bottlenecks that make overharvest more likely. The community fishery council will need this information when establishing fishing regulations for the river and its tributaries.
3. *Define allowable fishing gears and techniques*. Diverse gear-use is a challenge in establishing restrictions on small-scale fisheries (Salas *et al*., 2007). Additional gear restrictions may be necessary to maintain a viable fishery. Current gear restrictions include bans on electric fishing, chemical fishing, certain high-volume traps, and a few other techniques. Gill nets are currently legal, and are highly effective in catching many fish species, especially mobile species and non-target species such as the royal turtle. Mesh size largely determines the size of captured fish. Minimum mesh size restrictions could be used to allow smaller fish to evade capture, preventing recruitment overharvest by allowing juveniles to escape. Elimination of gill nets entirely, as implemented in the community fisheries of the Amazon (Almeida *et al*., 2009), should also be considered for long-term sustainability. Almeida *et al*. (2009) found that this excluded commercial fishing by outsiders and resulted in a 48% increase in catch for community fishers.
4. *Strengthen enforcement capacity*. Enforcement capacity poses a challenge to community fisheries in Cambodia (Ratner, 2006). The current use of illegal gears and non-sustainable harvest techniques concerns villages and needs to be addressed in the co-management agreement. The agreements should include local and national law enforcement agencies and explicitly state expectations and responsibilities. Some enforcement authority should be given to community representatives, but primary enforcement (confiscation of gears, arrests) needs to rest with enforcement agencies. Additional funding may be required to provide vessels and other equipment for enforcement, and potentially to hire conservation officer(s) to work on enforcement of community fishery laws and regulations.
5. *Visually display fishery regulations on the river*. Five out of six villages remarked that ignorance of the laws was often to blame for illegal fishing and agreed that well-placed signs on the river would help curb illegal activities. These signs could be placed on cables crossing river channels and indicate boundaries of the community fishery jurisdiction and protected zones within it. The signs could include easily understandable visuals for illiterate fishers.
6. *Develop plan to protect and restore riparian forests*. Protection of fisheries habitat is essential to a successful co-management plan (Pinkerton, 1989). On the Sre Ambel River system, floodplain habitat and particularly *Melaleuca* forest, appears to be important for the fishery in providing spawning and juvenile habitat during the wet season and pond refugia for brood stock during the dry season, as well as fishing opportunities during inundation. A sustainable policy for forest use and development is needed.
7. *Establish an enforceable sand mining/resource extraction policy*. Habitat destruction as a result of sand mining is a primary concern for fisheries and conservation of species such as the royal turtle in the Sre Ambel River system. The practice should be eliminated where possible. If allowed to continue, sand mining operations need to be better designed to minimize direct within-river impacts. This may include protection of riparian buffers and restrictions on mining of critical habitats, such as sand bars utilized by turtles for nesting, while allowing harvest of sand deposits further from the river bank. Following completion of mining activities at a location, habitat should be restored or created to benefit fish and other wildlife species. The responsibility and costs of restoration should be assigned to the extraction operation during the permitting process.
8. *Implement a standardized evaluation program*. Community development is only successful if demonstrable improvements are achieved. To demonstrate success, data must be collected before and after programme implementation. This requires ongoing assessment and could be achieved using a scientist-led or stakeholder-led approach. For the stakeholder-led approach, fishing logs could be created and distributed to village fishers with instruction on data recording. Fishers would record harvest data through time, allowing assessment of changes in catch associated with implementation of the community fishery and adherence to regulations.
9. *Develop an aquaculture outreach programme*. All villages were interested in aquaculture but did not have the financial means or expertise to get started. Development of educational programming could bridge the knowledge gap and facilitate aquaculture development in these communities. Further, a demonstration facility for aquaculture would be invaluable to educate and train interested villagers. The facility would need to be simple, inexpensive and replicable, with 2–3 gravity-fed ponds and easy to grow, readily available species. It could be constructed in a centrally located village, but should be used to train people from any village interested in aquaculture.

These recommendations address many of the issues identified during our community consultation process. While additional issues and concerns will undoubtedly arise during implementation of the community fishery, our approach has provided an important starting point

by generating basic fishery data where these did not exist and where traditional sampling methods were not feasible. We contend that the data provided by the Sre Ambel fishing villages are reasonably reliable and provide a valuable boost to the preliminary database for managing the fishery. Fisheries management is largely an adaptive process, composed of multiple iterations of trial and error, with each iteration learning from mistakes made previously (Neal, 2015). This is because natural fisheries are dynamic systems with a great deal of associated uncertainty. Managers rarely have enough information to make the best possible decisions for the stakeholders and the resource, and so must proceed with the information at hand.

Management uncertainty is exacerbated in developing countries such as Cambodia, where managers lack the funding and/or personnel to collect the data necessary for managing small-scale fisheries. In such situations, a user-based approach such as the one we employed can generate a significant amount of data with minimal investment, while simultaneously empowering local ownership and long-term planning to conserve important resources. Because our approach involved all primary stakeholders, including the fishers, researchers, collaborators, and the management authority, these data may be used to form initial objectives and management recommendations, which can be refined over time as newer data become available.

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Appendix 1 General questions posed during village stakeholder meetings in the Sre Ambel River system, Cambodia

Category	Audience	General Question Format
Demographics	Village chief	How many households/families in the village?
		Total number of people?
		Number of men? Women?
Poster Identification	All villagers	Which fish species are captured or otherwise important to the village?
		What other species are captured or otherwise important to the village?
Capture Fisheries	All villagers	Where do people fish? Does this change seasonally?
		How many people in village fish? Is fishing seasonal?
		When not fishing, what employment?
		Is fishing subsistence or small-scale commercial?
		What are the roles of men and women in fishing?
		What fishing gears are used?
		How are fish handled after capture? Is processing involved?
		What are the issues/challenges facing the fishery?
		Is outsider fishing or illegal fishing an issue?
		Is enforcement adequate?
Aquaculture	All villagers	Does aquaculture currently occur in the village? What species?
		Is there interest in developing aquaculture?
		What species and techniques?
		What are the limitations to aquaculture?
Assistance	All villagers	What do you need to be successful?
		How can we help?

Appendix 2 Freshwater, estuarine and marine fish species designated as high importance to villages in the Sre Ambel River system, Cambodia

#	Species
	Ambassidae
1	*Ambassis buruensis* (Bleeker 1856) Buru glass perchlet
2	*Ambassis kopsii* (Bleeker 1856) Singapore glassy perchlet
3	*Parambassis siamensis* (Fowler 1937)
	Anabantidae
4	*Anabas testudineus* (Bloch 1792)
	Ariidae
5	*Hexanematichthys sagor* (Hamilton 1822) Sagor catfish
	Bagridae
6	*Hemibagrus filamentus* (Fang & Chaux 1949)
7	*Hemibagrus nemurus* (Valenciennes 1840) Asian redtail catfish
8	*Mystus albolineatus* (Roberts 1994) whiteline catfish
9	*Mystus rhegma* (Fowler 1935)
10	*Mystus wolffi* (Bleeker 1951)
11	*Pseudomystus siamensis* (Regan 1913) Asian bumblebee catfish
	Belonidae
12	*Xenentodon cancila* (Hamilton 1822) freshwater garfish
	Channidae
13	*Channa gachua* (Hamilton 1822) walking snakehead
14	*Channa lucius* (Cuvier 1831)
15	*Channa micropeltes* (Cuvier 1831) Indonesian snakehead
16	*Channa striata* (Block 1793) striped snakehead
	Clariidae
17	*Clarias batrachus* (Linnaeus 1758) Philippine catfish
18	*Clarias macrocephalus* (Günther 1864) bighead catfish
19	*Clarias nieuhofii* (Valenciennes 1840) slender walking catfish
	Clupeidae
20	*Anodontostoma chacunda* (Hamilton 1822) Chacunda gizzard shad
	Cyprinidae
21	*Barbodes aurotaeniatus* (Tirant 1885)
22	*Barbodes rhombeus* (Kottelat 2000) spotted barb
23	*Barbonymus altus* (Günther 1868) red tailed tinfoil
24	*Barbonymus gonionotus* (Bleeker 1849) silver barb
25	*Barbonymus schwanenfeldii* (Bleeker 1854) tinfoil barb
26	*Crossocheilus atrilimes* (Kottelat 2000)
27	*Cyclocheilichthys apogon* (Valenciennes 1842) beardless barb
28	*Cyclocheilichthys armatus* (Valenciennes 1842) white eye barb
29	*Desmopuntius johorensis* (Duncker 1904) striped barb
30	*Discherodontus ashmeadi* (Fowler 1937)
31	*Esomus longimanus* (Lunel 1881) Mekong flying barb
32	*Esomus metallicus* (Ahl 1923) flying minnow
33	*Labiobarbus siamensis* (Sauvage 1881)
34	*Laubuka laubuca* (Hamilton 1822) Indian glass barb
35	*Mystacoleucus marginatus* (Valenciennes 1842)
36	*Opsariichthys bidens* (Günther 1873)
37	*Osteochilus lini* (Fowler 1935)
38	*Osteochilus microcephalus* (Valenciennes 1842)
39	*Osteochilus vittatus* (Valenciennes 1842) bonylip barb
40	*Osteochilus waandersii* (Bleeker 1853)
41	*Paralaubuca riveroi* (Fowler 1935)
42	*Poropuntius normani* (Smith 1931)
43	*Puntigrus partipentazona* (Fowler 1934) tiger barb
44	*Rasbora amplistriga* (Kottelat 2000)
45	*Rasbora aurotaenia* (Tirant 1885) pale rasbora
46	*Rasbora borapetensis* (Smith 1934) blackline rasbora
47	*Rasbora dusonensis* (Bleeker 1850) rosefin rasbora
48	*Rasbora hobelmani* (Kottelat 1984) Kottelat rasbora
49	*Rasbora paviana* (Tirant 1885) sidestripe rasbora
50	*Rasbora rubrodorsalis* (Donos-Büchner & Schmidt 1997)
51	*Rasbora tornieri* (Ahl 1922) yellowtail rasbora
52	*Scaphognathops stejnegeri* (Smith 1931)
	Datnioididae
53	*Datnioides polota* (Hamilton 1822) four-barred tigerfish
54	*Datnioides undecimradiatus* (Roberts & Kottelat 1994) Mekong tiger perch
	Eleotridae
55	*Butis koilomatodon* (Bleeker 1849) mud sleeper
56	*Oxyeleotris marmorata* (Bleeker 1852) marble goby
	Gerreidae
57	*Gerres filamentosus* (Culvier 1829) whipfin silver-biddy
	Hemiramphidae
58	*Hyporhamphus limbatus* (Valenciennes 1847) congaturi halfbeak
	Latidae
59	*Lates calcarifer* (Bloch 1790) barramundi
	Mastacembelidae
60	*Macrognathus circumcintus* (Hora 1924)
61	*Macrognathus maculatus* (Culvier 1832) frecklefin eel
62	*Macrognathus semiocellatus* (Roberts 1986) eyespot spiny eel
63	*Macrognathus siamensis* (Günther 1861) peacock eel
64	*Mastacembelus armatus* (Lacepède 1800) zig-zag eel
65	*Mastacembelus erythrotaenia* (Bleeker 1850) fire eel
66	*Mastacembelus favus* (Hora 1924) tire track eel

Appendix 2 Cont'd

#	Species
67	*Nandus nandus* (Hamilton 1822) Gangetic leaffish
	Notopteridae
68	*Notopterus notopterus* (Pallas 1769) bronze featherback
	Osphronemidae
69	*Betta splendens* (Regan 1910) Siamese fighting fish
70	*Osphronemus exodon* (Roberts 1994) elephant ear gourami
71	*Osphronemus goramy* (Lacepède 1801) giant gourami
72	*Trichopodus pectoralis* (Regan 1910) snakeskin gourami
73	*Trichopodus trichopterus* (Pallas 1770) three spot gourami
74	*Trichopsis vittata* (Cuvier 1831) croaking gourami
	Pristolepididae
75	*Pristolepis fasciata* (Bleeker 1851) Malayan leaffish

#	Species
	Scatophagidae
76	*Scatophagus argus* (Linnaeus 1766) spotted scat
	Siluridae
77	*Ompok urbaini* (Fang & Chaux 1949)
78	*Wallago micropogon* (Ng 2004)
	Synbranchidae
79	*Monopterus albus* (Zuiew 1793) Asian swamp eel
	Tetraodontidae
80	*Dichotomyctere ocellatus* (Steindachner 1870) eyespot puffer
81	*Pao cambodgiensis* (Chabanaud 1923)
82	*Pao cochinchinensis* (Steindachner 1866)
	Toxotidae
83	*Toxotes chatareus* (Hamilton 1822) spotted archerfish

Appendix 3 Freshwater, estuarine and marine fish species designated as medium importance to villages in the Sre Ambel River system, Cambodia

#	Species
	Ambassidae
1	*Parambassis apogonoides* (Bleeker 1851) iridescent glassy perchlet
2	*Ambassis gymnocephalus* (Lacepède 1802) bald glassy
3	*Ambassis vachellii* (Richardson 1846) Vachelli's glass perchlet
	Ariidae
4	*Arius maculatus* (Thunberg 1792) spotted catfish
5	*Arius venosus* (Valenciennes 1840) veined catfish
6	*Cryptarius truncatus* (Valenciennes 1840)
7	*Hemiarius stormii* (Bleekeri 1858) armoured sea catfish
8	*Nemapteryx caelata* (Valenciennes 1840) engraved catfish
9	*Netuma thalassina* (Rüppell 1837) giant catfish
10	*Osteogeneiosus militaris* (Linnaeus 1758) soldier catfish
11	*Sciades sona* (Hamilton 1822) Sona sea catfish
	Bagridae
12	*Bagrichthys macracanthus* (Bleeker 1854) black lancer catfish
13	*Bagrichthys obscurus* (Ng 1999)
14	*Hemibagrus spilopterus* (Ng & Rainboth 1999) blackspotted catfish
15	*Mystus atrifasciatus* (Fowler 1937)
16	*Mystus bocourti* (Bleeker 1864)
17	*Mystus multiradiatus* (Roberts 1992)
18	*Mystus mysticetus* (Roberts 1992)
19	*Mystus singaringan* (Bleeker 1846)
20	*Pseudomystus stenomus* (Valenciennes 1840)

#	Species
	Callionymidae
21	*Tonlesapia tsukwakii* (Motoura & Mukai 2006)
	Carangidae
22	*Carangoides bajad* (Forsskål 1775) orangespotted trevally
23	*Carangoides ferdau* (Forsskål 1775) blue trevally
24	*Carangoides hedlandensis* (Whitley 1934) bumpnose trevally
25	*Selar crumenophthalmus* (Bloch 1793) bigeye scad
26	*Selaroides leptolepis* (Cuvier 1833) yellowstripe scad
	Channidae
27	*Channa marulioides* (Bleeker 1851)
	Cichlidae
28	*Oreochromis mossambicus* (Peters 1852) Mozambique tilapia
29	*Oreochromis niloticus* (Linnaeus 1758) Nile tilapia
	Clariidae
30	*Clarias gariepinus* (Burchell 1822) North African catfish
31	*Clarias meladerma* (Bleeker 1846) blackskin catfish
	Clupeidae
32	*Clupeichthys aesarnensis* (Wongratana 1983) Thai river sprat
33	*Clupeichthys goniognathus* (Bleeker 1855) Sumatran river sprat
34	*Nematalosa nasus* (Bloch 1795) Bloch's gizzard shad
35	*Tenualosa thibaudeaui* (Durand 1940) Laotian shad
	Cynoglossidae
36	*Cynoglossus cynoglossus* (Hamilton 1822) Bengal tongue sole

Appendix 3 Cont'd

#	Species
	Cyprinidae
37	*Amblypharyngodon chulabhornae* (Vidthayanon & Keottelat 1990)
38	*Anematichthys repasson* (Bleeker 1853) Mekong barb
39	*Balantiocheilos ambusticauda* (Ng & Kottelat 2007) burnt tail fish
40	*Boraras urophthalmoides* (Kottelat 1991) least rasbora
41	*Crossocheilus reticulatus* (Fowler 1934) reticulate flying fox
42	*Cyclocheilichthys lagleri* (Sontirat 1989)
	Cyprinidae
43	*Garra fasciacauda* (Fowler 1937)
44	*Garra fisheri* (Fowler 1937)
45	*Hampala dispar* (Smith 1934)
46	*Hampala macrolepidota* (Kuhl & Van Hasselt 1823) Hempala barb
47	*Hypsibarbus lagleri* (Rainboth 1996)
48	*Hypsibarbus malcolmi* (Smith 1945) golden tinfoil barb
49	*Hypsibarbus pierrei* (Sauvage 1880)
50	*Hypsibarbus suvattii* (Rainboth 1996)
51	*Hypsibarbus wetmorei* (Smith 1931)
52	*Labeo chrysophekadion* (Bleeker 1849) black sharkminnow
53	*Laubuka caeruleostigmata* (Smith 1931) leaping barb
54	*Lobocheilos melanotaenia* (Fowler 1935)
55	*Lobocheilos rhabdoura* (Fowler 1934)
56	*Luciosoma setigerum* (Valenciennes 1842)
57	*Neolissochilus soroides* (Duncker 1904)
58	*Neolissochilus stracheyi* (Day 1871)
59	*Onychostoma gerlachi* (Peters 1881)
60	*Onychostoma ovale* (Pellegrin & Chevey 1936)
61	*Opsarius koratensis* (Smith 1931)
62	*Opsarius pulchellus* (Smith 1931)
63	*Parachela oxygastroides* (Bleeker 1852) glass fish
64	*Parachela siamensis* (Günther 1868)
65	*Paralaubuca barroni* (Fowler 1934)
66	*Paralaubuca harmandi* (Sauvage 1883)
67	*Paralaubuca typus* (Bleeker 1864)
68	*Poropuntius kontumensis* (Chevey 1934)
69	*Poropuntius laoensis* (Günther 1868)
70	*Probarbus jullieni* (Sauvage 1880) Isok barb
71	*Probarbus labeamajor* (Roberts 1992) thicklip barb
72	*Probarbus labeaminor* (Roberts 1992) thinlip barb
73	*Puntioplites bulu* (Bleeker 1851)
74	*Puntioplites proctozystron* (Bleeker 1865)
75	*Puntius brevis* (Bleeker 1849) swamp barb
76	*Rasbora daniconius* (Hamilton 1822) slender rasbora
77	*Rasbora myersi* (Brittan 1954) Myer's silver rasbora
78	*Rasbora trilineata* (Steindachner 1870) three-lined rasbora
79	*Systomus orphoides* (Valenciennes 1842) red cheek barb
80	*Trigonostigma espei* (Meinken 1967) lambchop rasbora
	Dasyatidae
81	*Hemitrygon laosensis* (Roberts & Karnasuta 1987) Mekong stingray
	Eleotridae
82	*Butis butis* (Hamilton 1822) duckbill sleeper
	Gerreidae
83	*Gerres erythrourus* (Bloch 1791) deep-bodied mojarra
	Gobiidae
84	*Aulopareia janetae* (Smith 1945) scalycheek goby
	Haemulidae
85	*Pomadasys maculatus* (Bloch 1793) saddle grunt
	Heteropneustidae
86	*Heteropneustes kemratensis* (Fowler 1937) stinging catfish
	Latidae
87	*Psammoperca waigensis* (Cuvier 1828) Waigeu seaperch
	Leiognathidae
88	*Eubleekeria splendens* (Cuvier 1829) splendid pony
89	*Leiognathus equulus* (Forsskål 1775) common ponyfish
	Lethrinidae
90	*Gymnocranius griseus* (Temminck & Schlegel 1843) grey large-eye bream
91	*Lethrinus nebulosus* (Forsskål 1775) spangled emperor
	Lutjanidae
92	*Lutjanus argentimaculatus* (Forsskål 1775) mangrove red snapper
93	*Lutjanus johnii* (Bloch 1792) John's snapper
94	*Lutjanus malabaricus* (Bloch & Schneider 1801) Malabar blood snapper
95	*Lutjanus russellii* (Bleeker 1849) Russell's snapper
	Mastacembelidae
96	*Macrognathus* sp.
	Mugilidae
97	*Crenimugil buchanani* (Bleeker 1853) bluetail mullet
98	*Crenimugil seheli* (Forsskål 1775) bluespot mullet
99	*Ellochelon vaigiensis* (Quoy & Gaimard 1825) squaretail mullet
	Nemacheilidae
100	*Schistura kengtungensis* (Fowler 1936)
101	*Schistura magnifluvis* (Kottelat 1990)
	Ophichthidae
102	*Ophichthus rutidoderma* (Bleeker 1852) olive snake eel

Appendix 3 Cont'd

#	Species
	Osphronemidae
103	*Betta prima* (Kottelat 1994)
104	*Trichopodus microlepis* (Günther 1861) moonlight gourami
105	*Trichopsis pumila* (Arnold 1936) pigmy gourami
106	*Scleropages formosus* (Müller & Schlegel 1840) Asian bonytongue
	Pangasiidae
107	*Helicophagus waandersii* (Bleeker 1858)
108	*Pangasianodon hypophthalmus* (Sauvage 1878) striped catfish
109	*Pangasius djambal* (Bleeker 1846)
110	*Pangasius larnaudii* (Bocourt 1866) spot pangasius
	Plotosidae
111	*Plotosus canius* (Hamilton 1822) grey eel-catfish
112	*Plotosus lineatus* (Thunberg 1787) striped eel catfish
	Scombridae
113	*Rastrelliger brachysoma* (Bleeker 1851) short mackerel
	Serranidae
114	*Cephalopholis boenak* (Bloch 1790) chocolate hind
115	*Cephalopholis formosa* (Shaw 1812) bluelined hind
116	*Cephalopholis miniata* (Forsskål 1775) coral hind
117	*Cromileptes altrivelis* (Valenciennes 1828) humpback grouper
118	*Epinephelus amblycephalus* (Bleeker 1857) banded grouper
119	*Epinephelus areolatus* (Forsskål 1775) areolate grouper
120	*Epinephelus coioides* (Hamilton 1822) orange-spotted grouper
121	*Epinephelus quoyanus* (Valenciennes 1830) longfin grouper
122	*Epinephelus sexfaciatus* (Valenciennes 1828) sixbar grouper
	Siganidae
123	*Siganus argenteus* (Quoy & Gaimard 1825) streamlined spinefoot
124	*Siganus canaliculatus* (Park 1797) white-spotted spinefoot
125	*Siganus guttatus* (Bloch 1787) orange-spotted spinefoot
126	*Siganus javus* (Linnaeus 1766) streaked spinefoot
	Siluridae
127	*Kryptopterus cheveyi* (Durand 1940)
128	*Kryptopterus dissitus* (Ng 2001) Indochinese sheatfish
129	*Ompok bimaculatus* (Bloch 1794) butter catfish
130	*Ompok eugeneiatus* (Vaillant 1893) Malay glass catfish
131	*Pterocryptis torrentis* (Kobayakawa 1989)
132	*Silurichthys hasseltii* (Bleeker 1858)
133	*Silurichthys schneideri* (Volz 1904)
134	*Wallago leeri* (Bleeker 1851) striped wallago catfish
	Synbranchidae
135	*Macrotrema* sp.
136	*Ophisternon bengalense* (McClelland 1844) beneal eel
	Tetraodontidae
137	*Dichotomyctere nigroviridis* (Marion de Procé 1822) spotted green pufferfish
138	*Pao baileyi* (Sontirat 1985) hairy puffer
	Toxotidae
139	*Toxotes microlepis* (Günther 1860) smalescale archerfish
	Zenarchopteridae
140	*Zenarchopterus buffonis* (Valenciennes 1847) Buffon's river-garfish
141	*Zenarchopterus ectuntio* (Hamilton 1822) halfbeak

Appendix 4 Aquatic non-fish species designated as high importance to villages in the Sre Ambel River system, Cambodia

#	Species
Crustaceans	
	Attidae
1	*Neocaridina serrata*
2	*Neocaridina* sp.
	Gecarcinucidae
3	*Somaniathelpusa* spp. black rice crab
	Palaemonidae
4	*Macrobrachium lotidachylus*
5	*Macrobrachium nipponese*
6	*Macrobrachium ohione*
7	*Macrobrachium rosenbergii* giant freshwater prawn
	Potamidae
8	*Johora tiomanensis*
Molluscs	
	Ampullaridae
9	*Pila gracilis* apple snail
10	*Pila scutata* Pila snail
	Viviparidae
11	*Mekongina pongensis* aeruginose snail
12	*Mekongina* sp.

Appendix 4 Cont'd

#	Species
Reptiles	
	Geoemydidae
13	*Batagur* spp. royal turtle or mangrove turtle
14	*Cuora amboinensis* Asian box turle
15	*Heosemys annandalii* yellow-headed temple turtle
16	*Heosymes grandis* Asian giant terrapin
17	*Malayemys subtrijuga* rice-field terrapin
18	*Siebenrockiella crassicollis* black marsh turtle
	Testudinidae
19	*Indotestudo elongata* elongated tortoise
	Trionychidae
20	*Amyda cartilaginea* Asiatic soft-shell turtle

