

## Section 1: Fisheries Assessment



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# Monitoring sales of fish and other aquatic animals at retail markets in Phnom Penh, Cambodia

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## ABSTRACT

Phnom Penh, Cambodia's capital city has a population of over one million people, of which about 700,000 live in the main central urban area. Inland fish and other aquatic animals are sold at 29 main markets that are supplied from several landing sites and from other diverse sources. We monitored sales at six of these markets in early 2003 and assessed the total numbers of traders in late 2003. Fresh inland fish comprised about 85% of the weight sold of all fresh fish and other aquatic animals. Snakeheads (Channidae) comprised around 40% by weight of all fresh inland fish sold, and with a few other species, made up most of the sales. Exotic species (from aquaculture) comprised only about 1% of sales, so virtually all fresh fish sold were indigenous wild fish or indigenous species grown in floating cages and fed on other small wild fish of lower value. Hence, wild inland fish (either directly or indirectly) still provide most of Phnom Penh's fish supply. The most important other aquatic animals were marine and freshwater shrimps (Penaeidae and Palaemonidae).

In the 29 markets, over 2,000 people sell aquatic products and about 90% of sellers are female. Based on our limited data, the total daily inland fresh fish sales in these markets were of the order of 12 tonnes/day in March-May and 19 tonnes/day in October 2003, with a value of US\$15-24,000 per day. Preserved inland fish sales are also very important but were not quantified. This small-scale industry is the primary supplier of fish to the city and is a significant employer, in particular providing opportunities for women in an environment where they can manage their own businesses. Fish marketing also supports many associated industries.

Sales showed no daily patterns and quantities generally varied by about 10-20% from day-to-day. A five-day monitoring programme would therefore provide quite representative data for any market. Monitoring markets poses particular challenges that require novel approaches which we discuss for those planning similar studies.

**KEY WORDS:** Cambodia, Mekong, fisheries, markets

## INTRODUCTION

The residents of Phnom Penh, like those of many large cities in Southeast Asia, rely on local retail markets to provide the fresh and preserved aquatic produce that forms an essential part of their diet. Because they are intermediate between producers and consumers, monitoring sales in these markets can reveal trends in the type, quantity and price of produce available.

This paper documents three such monitoring surveys carried out in central Phnom Penh during 2003. Data from a fourth survey, which involved long-term monitoring by a selected group of 20 traders in six markets, is not yet ready for publication. The completed surveys include:

1. An initial 15-day survey of one large market, Bang Keng Kong; this was a trial survey designed to evaluate the time and procedures required to carry out a short, intensive, 'whole-market' fresh fish survey of a selected group of markets. In this phase, conducted during early 2003, we monitored all market stalls that sold fresh fish. Data from the survey helped to identify patterns,

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or trends, in fresh fish sales and to evaluate if produce from 'outlying' sources were causing duplication of some results.

2. Five-day 'whole-market' fresh fish surveys (also conducted in early 2003) of five more markets: Chass, Central, Olympic, Toul Tom Pong and Oresey markets. These, together with Bang Keng Kong, form a group of six 'key markets' that are the source of the data used in the analysis of the 'whole-market fresh fish' surveys and most of the data used in the analysis of the 'market-frame' surveys (see Results section).
3. A 'market-frame' survey involving 29 markets; in the process of interviewing traders during the earlier surveys, we learned that 29 markets in central Phnom Penh sell fish, a far greater number than the five to ten we had assumed previously. As a result, the 'market-frame' survey, conducted during October and November 2003, included 23 new markets in addition to the six 'key markets' surveyed earlier in the year.
4. As well as providing a general description of the fish markets, this study aimed to establish if it is possible to obtain accurate data on sales, to document aspects of the methods of surveying and estimate the cost of implementing such monitoring. The study also sought to establish whether surveys of this type would reveal broader trends in the fisheries, such as the changes in the number and type of species, the size of individual species on sale and prices.

Phnom Penh, the capital city of Cambodia since 1866, is located in the centre of the productive floodplains near the confluence of the Tonle Sap (Sap River) and Mekong River (Griffiths 2000). Although depopulated under the rule of the Khmer Rouge (1975 – 79), the city has since been re-occupied and largely re-built or newly built. Rapid expansion since 1995 and major infrastructural changes (to roads, buildings, energy supply, and the airport) in 2001-2003 have dramatically transformed the city. Along with this transformation and a rapidly expanding population has come an expansion of trade both into and out of Phnom Penh.

The 1998 census (National Institute of Statistics 1999) recorded a population of approximately one million people in the city. About 60% of these people live in the main urban area, which sprawls west along the airport road (Figure 1). The national annual population growth rate is 2.5%. In the city, this figure is higher; in 2003 the population of central Phnom Penh was probably in the region of 700,000 people.

The urban area is mainly medium-density, with shop-houses and stores along larger streets. Small streets and alleys connect a diverse mix of dwellings. Dense aggregations of makeshift houses line waterways and spread across vacant lands. Most of the inhabitants buy their food supplies in traditional Asian-style markets that have been re-developed (or have sprung up) over the last decade in response to the improved security situation and a stabilised cash economy.

As our studies only began in 2003, and much of the analysis of the data is still ongoing, this paper can only present some of the initial findings. We hope, however, that the paper is a useful introduction to the

methods of monitoring fish sales and that it will give some guidance to other researchers who wish to undertake similar studies. We are confident that, while our paper deals with markets in Phnom Penh, the lessons learned during our studies will be applicable throughout the region.

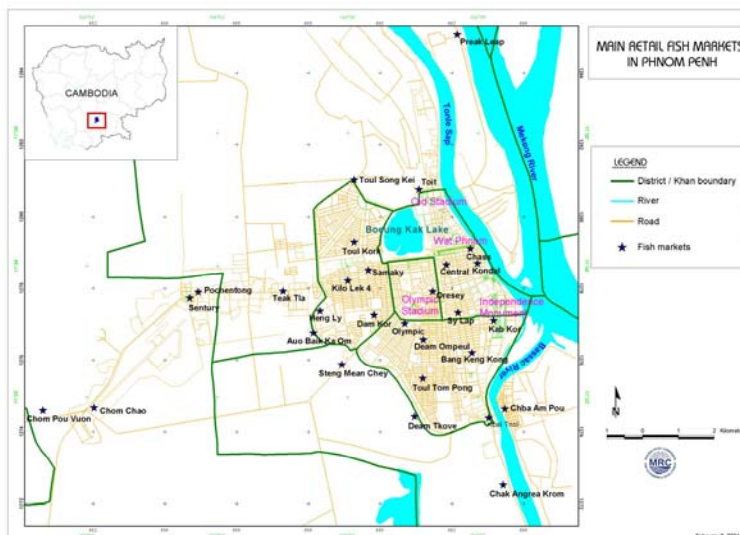


Figure 1. Location of main retail markets in Phnom Penh

### Structure of the markets

Large retail markets are highly visible and accessible covering whole city blocks in Phnom Penh; Central Market, for example, covers approximately four hectares. Smaller markets are less obvious, and access via narrow streets or alleys is restricted. Older, generally well-constructed markets with cement walls, stalls and roofs, date back to the French colonial period (Central Market was built in 1937), whereas the newer markets are ramshackle with constructed stalls of varying degree and quality. All



Figure 2. A typical stall in the uncovered area of Chass market showing *Pangasius* and cyprinids for sale

spread to some extent onto adjacent streets and alleys, hindering accurate enumeration of stallholders.

In the markets, numerous small stallholders sell a wide range of fresh and preserved produce most of which is brought in daily from suppliers close by. Stallholders have to pay a minimal fee to a market manager who takes charge of policing the market and pays rent to the local council. All purchases are for cash; traders accept US dollars as well as other foreign currencies, along with the Cambodian currency, the *Riel*.

Phnom Penh has a few Western-style supermarkets that cater to a small affluent population. Foodstuffs typically found in supermarkets are also available in traditional markets; here they sell, along with various consumer products, in bulk or in smaller amounts. In the traditional markets, food produce is rarely refrigerated. Although some traders do use ice, most sell fish, and other food products, either alive or freshly killed. The lack of refrigeration favours retailing of fish, such as snakeheads (Channidae) and climbing perch (Anabantidae), able to survive with little water as well as other aquatic animals (OAAs) such as frogs, crabs and turtles that can tolerate long periods without water. Many traders kill and process live animals immediately prior to sale and sell large quantities of preserved fish and OAAs (salted, dried, fermented, or made into paste or sauce).



Figure 3. Drying snakehead and *Pangasius* fillets outside Oresey Market; the largest market for preserved fish

### *Monitoring fish sales*

When this study began in early 2003, we believed that only five to ten markets in central Phnom Penh sold significant quantities of fish. However, while we were monitoring the six key markets, traders and others told us that many more markets than these sold large amounts of fish. Eventually, 29 retail markets were included in the study. We also found trading within or between markets is a common practice. Traders may re-sell produce in the same or different markets; some buy produce from wholesale markets, such as Oresey, and then re-sell it in other retail markets. Indeed, because of this inter and intra-market commerce our records probably include the same fish sold twice or more.

Those who are familiar with cities that host large centralised markets with established data collection systems might be surprised by the sheer diversity of fish on sale in Phnom Penh and by the lack of accurate official data. Therefore, as well as providing a general description of the fish markets, this study also evaluates feasibility of acquiring accurate data and assesses the methodologies and costs involved in such monitoring. In addition, we wanted to know if these data would bring to light broader trends in the fisheries such as changes in the composition of species, size and price. As the study only began in 2003, this paper serves simply as an introduction to the subject and provides a limited analysis of the data to illustrate some key points for those wishing to pursue similar studies.

#### *Sources of aquatic products*

Products for sale in the markets of Phnom Penh come from landing sites along the Tonle Sap River, or from wholesalers of live fish, as well as a variety of other dispersed sources. Three of the major landing sites are on the Tonle Sap. The four principle sources are:

1. Chiriang Chomreh, the main site, is 9 km north-west of Phnom Penh and receives fish from many sources around the city including: fishing lots and fish cages on the Tonle Sap and Great Lake, the Mekong and Bassac Rivers, and by barge from Viet Nam. From discussions with on-site traders and our own visual inspections, we estimate daily sales during October 2003, were in the region of 20-30 tonnes.
2. Ratini, a smaller but similar site, situated approximately 2 km upstream of Chiriang Chomreh, sells mostly live fish (mainly tilapia and *Pangasius*) from pond and cage culture. Daily sales are in the order of 10-20 tonnes.
3. Chnok Tru is a large fish processing area situated approximately 160 km upstream at the entrance to the Great Lake. Truck or barges transport large quantities of fish from this site to Phnom Penh; apparently Chiriang Chomreh or Chba Am Pou wholesale markets sell most of these fish (see Table 1). At Chnok Tru, poor-quality river fish considered unfit for human consumption sell mainly as feed for fish reared in ponds along the Tonle Sap and Great Lake; these fish are also largely destined for Phnom Penh.
4. Adjacent to Chba Am Pou, beside the Bassac River close to Phnom Penh, is another fish market that sells only live snakeheads, mostly large *Channa micropeltes*, but also some smaller *Channa striata*. Traders bring live fish to this market in metal containers on trucks mainly from the site of a river ferry on the Mekong at Neak Leuong, approximately 60 km downstream of Phnom Penh. These fish arrive at Neak Leuong by boat from cage culture operations in southern Cambodia and Viet Nam. Several other provinces, including Kandal, Kratie, Kampong Chhnang, Chhnok Tru and Preay Veng, also send snakeheads to this wholesale market. The owner of the market estimates these various sources bring in between five to seven tonnes daily.

We estimate that in 2003 these four wholesale markets sold between 35-60 tonnes of fish per day. Although market traders outside the urban area buy some fish, most was destined for retail markets in

Phnom Penh. In addition, in a city where people commonly chose to eat out, restaurateurs probably account for significant additional sales.

As well as buying from wholesale markets many stallholders trade directly with fishers, farmers, collectors, and intermediaries, who bring small quantities of fish into the city from the surrounding countryside by motorbike, some travel up to 50 km/day to do so. Retailers are typically female; a few have their own small ponds or access to other sources of fish. Husbands commonly purchase and transport products, or help their wives to purchase and transport their goods. Whilst it is not possible at this stage to quantify total fish and OAAs from these diverse sources, they certainly boost the figures of produce coming to the cities wholesale markets.

Trucks also bring fresh and preserved fish and OAAs from Cambodia's substantial marine coastal fisheries through ports at Kompot and Kompong Som, about 160 and 230 km respectively from Phnom Penh. Most traders sell either marine or inland produce; few sell both.



Figure 4. Processing of snakehead (*Channa micropeltes*) at Chiriang Chomreh; the largest wholesale market in Phnom Penh

## METHODS OF TRIAL MONITORING

### *Whole-market fresh fish monitoring*

This study, initially focused on one large market (Bang Keng Kong), monitored and recorded the fresh fish sales of all traders over a period of 15 days. The objective was to document day-to-day variations in sales and to determine the amount of time needed to carry out a short, intensive, market survey. Within this period, it was possible to establish if patterns existed and to determine whether outlying sources were causing a duplication of results.

Each day, the monitoring team questioned sellers about the amount and type of fish and OAAs they had for sale, and visually corroborated their replies. Whilst they do not keep accurate written records of sales, traders own, and use, reasonably accurate (based on limited checks) weighing scales. In addition,



sellers are able to judge weight quite well (also based on limited testing of individual sellers).

It is important to understand that traders are generally reluctant to discuss the details of their sales. They are busy, there is no incentive to answer questions, and they are concerned about the possible repercussions (such as taxation) of doing so. In addition, they believe that it is unlucky to discuss sales early in the morning. However, their reluctance was over come by offering a small monetary incentive of ten to twenty US cents a day.

Following the survey at Bang Keng Kong Market, we extended the scope of the monitoring to include sellers at five other large markets; these new surveys lasted five days each.

#### *Market frame survey*

In order to ensure that future monitoring is representative, we undertook a market-frame survey to identify the key characteristics of the markets' fish trade. These included the number of stalls, the gender of the sellers and the broad categories of produce on sale. For the purpose of the survey, we define a 'stall' as any site selling fish; it may be a clearly marked space within a regulated area of the market or just a simple site where traders spread their produce on a floor mat. Both covered and uncovered areas of the markets hold fish stalls. However, because they are more difficult to access we restricted our survey of the uncovered areas to the six 'key markets'.

In these six 'key markets' we counted the number of stalls selling different kinds of aquatic produce; inland indigenous fresh fish, inland introduced fresh fish, inland fresh OAA, and so on. The details of theses categories are given in Table 2. In the other 23 markets we counted only the stalls that sold fresh inland fish. However, because we believe that it is representative of all markets, we used the data recorded in the six 'key markets' to gain an overall impression the fish-market trade in Phnom Penh by extrapolating this data to the other 23 markets in the survey.



Figure 5. A typical two-female stall in the covered area of Central Market

*Fish Identification and Taxonomy*

With two exceptions, we used Mekong Fish Database (MFD 2003) to identify fish species. The common bagrid catfish, formerly referred to as *Mystus nemurus* and incorrectly attributed to *Hemibagrus filamentus* in the MFD, is classified here as *Hemibagrus* aff. *nemurus* in accordance with Kottelat (2001); in the case of the common cyprinid, *trey riel*, the classification by Roberts (1997) is adhered to. This taxon comprises two common species: *Cirrhinus lobatus* and *Cirrhinus siamensis*, which some authors classify as *Henicorhynchus*. Time constraints prevented us from separating the other cyprinid species sometimes sold with *trey riel*.

## RESULTS

Table 1. Number of stalls and traders (subdivided by gender) selling inland fresh fish in covered market areas, central Phnom Penh

| Name of market                       | Stalls     |           |                   |              | Sellers    |            |              |
|--------------------------------------|------------|-----------|-------------------|--------------|------------|------------|--------------|
|                                      | 1 female   | 2 female  | 1 male & 1 female | Total stalls | Female     | Male       | Total        |
| Bang Keng Kong                       | 24         | 4         | 14                | 42           | 46         | 14         | 60           |
| Chass                                | 33         | 1         | 2                 | 36           | 37         | 2          | 39           |
| Central                              | 38         | 4         | 4                 | 46           | 50         | 4          | 54           |
| Olympic                              | 59         | 5         | 17                | 81           | 86         | 17         | 103          |
| Toul Tom Pong                        | 23         | 6         | 12                | 41           | 47         | 12         | 59           |
| Oresey                               | 37         | 4         | 5                 | 46           | 50         | 5          | 55           |
| <b>Total for the six key markets</b> | <b>214</b> | <b>24</b> | <b>54</b>         | <b>292</b>   | <b>316</b> | <b>54</b>  | <b>370</b>   |
| Dam Kor66                            | 66         | 10        | 15                | 91           | 101        | 15         | 116          |
| Kon Dal                              | 75         | 4         | 4                 | 83           | 87         | 4          | 91           |
| Chba Am Pou                          | 50         | 5         |                   | 55           | 60         | 0          | 60           |
| Samaky                               | 46         | 1         | 3                 | 50           | 51         | 3          | 54           |
| Toit                                 | 38         |           | 5                 | 43           | 43         | 5          | 48           |
| Toul Song Kei                        | 22         | 5         | 3                 | 30           | 35         | 3          | 38           |
| Pochentong                           | 27         | 4         | 1                 | 32           | 36         | 1          | 37           |
| Teak Tla                             | 29         |           | 4                 | 33           | 33         | 4          | 37           |
| Kbal Tnol                            | 14         |           | 7                 | 21           | 21         | 7          | 28           |
| Kilo Lek 4                           | 22         |           | 2                 | 24           | 24         | 2          | 26           |
| Sentury                              | 22         | 1         |                   | 23           | 24         | 0          | 24           |
| Preak Leab                           | 13         | 5         |                   | 18           | 23         | 0          | 23           |
| Deam Tkove                           | 22         |           |                   | 22           | 22         | 0          | 22           |
| Steng Mean Chey                      | 12         |           | 2                 | 14           | 14         | 2          | 16           |
| Deam Ompeul                          | 9          | 1         | 2                 | 12           | 13         | 2          | 15           |
| Kab Kor                              | 15         |           |                   | 15           | 15         | 0          | 15           |
| Chom Pou Vuon                        | 11         |           |                   | 11           | 11         | 0          | 11           |
| Chak Angrea Krom                     | 6          |           | 2                 | 8            | 8          | 2          | 10           |
| Toul Kork                            | 9          |           |                   | 9            | 9          | 0          | 9            |
| Auo Baik Ka Om                       | 6          |           | 1                 | 7            | 7          | 1          | 8            |
| Chom Chao                            | 7          |           |                   | 7            | 7          | 0          | 7            |
| Sy Lap                               | 7          |           |                   | 7            | 7          | 0          | 7            |
| Heng Ly                              | 4          |           |                   | 4            | 4          | 0          | 4            |
| <b>Total for all markets</b>         | <b>746</b> | <b>60</b> | <b>105</b>        | <b>911</b>   | <b>971</b> | <b>105</b> | <b>1,076</b> |

Note: Data collected between Oct and Nov 2003. Only the first six markets were monitored in detail. The table does not include sellers in uncovered areas, sellers of OAAs or sellers of marine produce.

*Market frame survey*

Nine hundred and eleven stalls in the covered areas of the 29 markets sold fresh inland fish (Table 1). However, in the six 'key markets' in addition to the 292 stalls in the covered areas a further 114 stalls also sold fresh inland fish, making 406 in total. In these markets, the ratio of total stalls/stalls in covered areas was 1:1.39 (406/292). Using this ratio to extrapolate to the other 23 markets, we estimate that, in total, 1,267 stalls and 1,496 traders sell fresh inland fish.

In the six 'key markets', 684 stalls sold one or more of the categories of fish and OAAs listed in Table 2. Of these, 573 (83.8%) sold inland products, 143 (20.9%) sold marine products and 32 sold both. The ratio of stalls selling any aquatic product to those selling fresh inland fish was 1:1.68 (684/406). By multiplying total estimated number of fresh inland fish stalls (1,267 - derived from Table 1) by this ratio we concluded that, in all, 2,129 stalls sold some kind of aquatic product.

Using the same ratio we estimate the total number of sellers of all aquatic products to be about 2,512 of which some 2,104 (83.8%) sold inland fish and OAAs. Approximately 90% of the traders sampled were female; we considered this high proportion representative of all the markets. As well the sellers, other people working for the stalls include labourers, generally on a part-time basis, and husbands, who commonly assist with transportation as well as other tasks; these additional workers add considerably to total number of people employed in the trade.

Table 2. *Number of stalls selling each category of product in the six key monitored markets*

| Category             | Bang Keng Kong | Chass     | Central   | Olympic    | Toul Tom Poong | Oresey     | Total      | %           |
|----------------------|----------------|-----------|-----------|------------|----------------|------------|------------|-------------|
| Inland FF Indigenous | 45             | 40        | 46        | 85         | 69             | 111        | 396        | 58%         |
| Inland FF Introduced | 7              | 3         | 1         |            | 1              | 10         | 22         | 3%          |
| Inland PF Indigenous | 9              | 10        | 15        | 17         | 23             | 82         | 156        | 23%         |
| Inland PF Introduced |                |           |           |            |                |            |            | 0%          |
| Inland OAA Fresh     | 21             | 6         | 15        | 26         | 28             | 41         | 137        | 20%         |
| Inland OAA Preserved |                | 4         | 3         | 3          | 2              | 3          | 15         | 2%          |
| Marine FF            | 5              | 3         | 10        | 6          | 10             | 13         | 47         | 7%          |
| Marine PF            |                |           | 9         | 4          | 5              | 35         | 53         | 8%          |
| Marine OAA Fresh     | 2              | 2         | 18        | 11         | 5              | 19         | 57         | 8%          |
| Marine OAA Preserved |                |           | 2         | 4          |                | 27         | 33         | 5%          |
| <b>Inland FF All</b> | <b>45</b>      | <b>40</b> | <b>47</b> | <b>85</b>  | <b>70</b>      | <b>119</b> | <b>406</b> | <b>59%</b>  |
| <b>Inland All</b>    | <b>51</b>      | <b>46</b> | <b>65</b> | <b>105</b> | <b>95</b>      | <b>211</b> | <b>573</b> | <b>84%</b>  |
| <b>Marine All</b>    | <b>6</b>       | <b>4</b>  | <b>33</b> | <b>19</b>  | <b>17</b>      | <b>64</b>  | <b>143</b> | <b>21%</b>  |
| <b>Total</b>         | <b>55</b>      | <b>49</b> | <b>90</b> | <b>119</b> | <b>109</b>     | <b>262</b> | <b>684</b> | <b>100%</b> |

*Notes:* Data from October and November 2003. FF=fresh fish, PF=preserved fish, OAA=other aquatic animals. Totals are those stalls selling either or both of the included categories rather than the sum. The percentages do not add up to 100% because some stalls sell products in more than one category.

Table 3 shows the total quantity of all aquatic produce available for sale on a single day during the onset of the flood recession (October to November). At this time of year much of the fish and OAAs on sale is in the form of preserved produce, however, we were unable to get information on daily sales of this type

of foodstuff from the sellers. At Oresey, by far the most important market for preserved fish, traders sell a large variety of dried, salted and fermented fish products, both in bulk and in smaller amounts. As other markets often resell produce originating from Oresey, the large quantities we recorded to some extent reflect double counting.

Table 3. *Weight (kg) of all aquatic products on sale on a single day in the six key monitored markets*

| Category             | Bang Keng Kong | Chass        | Central      | Olympic      | Toul Tom Poong | Oresey        | Total         | %          |
|----------------------|----------------|--------------|--------------|--------------|----------------|---------------|---------------|------------|
| Inland FF Indigenous | 1,453          | 888          | 962          | 1,672        | 1,319          | 2,102         | 8,395         | 21         |
| Inland FF Introduced | 46             | 12           | 15           | 0            | 2              | 186           | 261           | 1          |
| Inland PF Indigenous | 111            | 165          | 778          | 486          | 390            | 21,110        | 23,040        | 58         |
| Inland PF Introduced | 0              | 0            | 0            | 0            | 0              | 0             | 0             | 0          |
| Inland OAA Fresh     | 223            | 46           | 154          | 213          | 143            | 375           | 1,154         | 3          |
| Inland OAA Preserved | 0              | 23           | 18           | 14           | 9              | 39            | 103           | 0          |
| Marine FF            | 47             | 32           | 1,037        | 62           | 145            | 166           | 1,489         | 4          |
| Marine PF            | 0              | 0            | 773          | 48           | 59             | 851           | 1,731         | 4          |
| Marine OAA Fresh     | 25             | 105          | 1,640        | 162          | 135            | 708           | 2,775         | 7          |
| Marine OAA Preserved | 0              | 0            | 60           | 35           | 0              | 680           | 775           | 2          |
| <b>Inland FF All</b> | <b>1,499</b>   | <b>900</b>   | <b>977</b>   | <b>1,672</b> | <b>1,321</b>   | <b>2,288</b>  | <b>8,656</b>  | <b>22</b>  |
| <b>Inland All</b>    | <b>1,833</b>   | <b>1,133</b> | <b>1,927</b> | <b>2,385</b> | <b>1,863</b>   | <b>23,812</b> | <b>11,952</b> | <b>30</b>  |
| <b>Marine All</b>    | <b>72</b>      | <b>137</b>   | <b>3,510</b> | <b>307</b>   | <b>339</b>     | <b>2,405</b>  | <b>6,770</b>  | <b>17</b>  |
| <b>Totals</b>        | <b>1,905</b>   | <b>1,270</b> | <b>5,437</b> | <b>2,692</b> | <b>2,202</b>   | <b>26,217</b> | <b>39,722</b> | <b>100</b> |

Notes: Data from October–November 2003. FF=fresh fish, PF=preserved fish, OAA=other aquatic animals. Amounts of preserved products are for daily quantities ‘on sale’ and not daily quantities sold, whereas amounts of fresh fish are approximate daily sale quantities.

The amount of fresh inland fish on sale at this time (8,656 kg) was nearly two and a half times the amount on sale during the whole-market survey carried out in February to May (the combined average daily sales at Bang Keng Kong and the other five ‘key markets’ was 3,708 kg – Tables 5 and 6). This increased volume is a result of higher catches at the start of the flood recession period.

We multiplied the total weight of fresh inland fish sales in the six markets by the ratio of stalls in all markets to stalls in the six ‘key markets’ (911/406) to estimate the total quantity of fresh inland fish on sale in one day. This estimate, of 19.4 tonnes, is considerably lower than the estimates of fish brought into the city from wholesale markets (35–60 tonnes) made at about the same time. While sellers market some fish via other channels, this discrepancy suggests the wholesale market figures are overestimates. Increased sales of preserved fish made up for the lower level of fresh fish sales earlier in the year (approximately 12 tonnes/day).

#### *Whole market fresh-fish monitoring*

Table 4 summarises the data obtained from the 15-day survey of Bang Keng Kong market; it shows that while inland fish comprised the bulk of fresh aquatic animals sold, per kilogram they realised less value than OAAs. Marine fish accounted for only a small portion of sales (2.8%) and were on average less valuable than inland fish. Virtually all of the inland fish were indigenous species; the only introduced species recorded during the period of the survey, the Nile tilapia (*Oreochromis niloticus*), comprised

less than 1% of the total sales. On average, marine invertebrates (squid, cuttlefish, shrimps and crabs) realised a higher value than fish.

Table 4. *Summary of 15-day survey of fresh aquatic animals on sale at Bang Keng Kong market, central Phnom Penh*

| Origin     | Sub-category | Total (kg)    | %    | Value (Riel)      | Value (US\$)  | %    | Mean US\$/kg |
|------------|--------------|---------------|------|-------------------|---------------|------|--------------|
| Inland     | Fish         | 14,676        | 88.3 | 73,167,716        | 18,292        | 77.6 | 1.25         |
| Inland     | OAAs         | 560           | 3.4  | 6,692,200         | 1,673         | 7.1  | 2.99         |
| Inland     | Sub-total    | 15,236        | 91.6 | 79,859,916        | 19,965        | 84.7 | 1.31         |
| Marine     | Fish         | 467           | 2.8  | 1,772,000         | 443           | 1.9  | 0.95         |
| Marine     | OAAs         | 925           | 5.6  | 12,681,000        | 3,170         | 13.4 | 3.43         |
| Marine     | Sub-total    | 1,392         | 8.4  | 14,453,000        | 3,613         | 15.3 | 2.60         |
| <b>All</b> | <b>Total</b> | <b>16,628</b> |      | <b>94,312,916</b> | <b>23,578</b> |      | <b>1.42</b>  |

Notes: Data collected between 21 Feb and 7 Mar 2003. US\$1.00 = Riel 4,000

We could not easily differentiate produce from wild fisheries from that sourced from aquaculture. In fact, little 'pure' aquaculture is practised near Phnom Penh; usually wild fish are caught as fingerlings and reared, or if they are larger, fattened or 'grown-out', in cages and ponds. Wild fish, either freshly caught or as a component of fishmeal, also provide most of the fish used in feed for aquaculture.

The variability of fish sales at the Bang Keng Kong market during in the 15-day monitoring period are summarised in Figure 6. Total sales of inland fresh fish ranged from 481 to 1,590 kg/day.

The six most common of the 52 fish species recorded made up about 53% of total sales by weight (Figure 6). The data shows no patterns suggestive of regular weekly variations in sales and traders confirmed that there were no particularly important days when sales may be higher or lower. Weekend sales are also indistinguishable from weekday sales. Sales were unusually low on 1 March because on that day many sellers attended a wedding.

Choosing the optimum duration of a survey that will both generate valid results and be cost effective is difficult because variation of sales volumes has no apparent cause. On one hand, monitoring on this scale, and for this length of time, is very difficult to sustain. On the other hand, surveying the market for just a single day could prove misleading because the total catch varies daily and there a risk the survey will hit an unpredictable unrepresentative day, such as the day of the wedding.

However, based on our experience of the earlier surveys, we believed that a five-day period is sufficient to obtain valid and representative samples. In order to test this assumption, we calculated five-day rolling averages from the data recorded during the 15-day survey of Bang Keng Kong market (Table 5). As the five-day rolling averages lie with the range of +15% to -18% of the 15-day mean, we concluded that five-day surveys will provide valid data, and that the days thus freed up are better spent assessing more markets. However, taken individually, the variability of the most common species is greater than the whole population; this may be significant depending on the objectives of future surveys.

The value of sales shows similar variability, for example the 5-day rolling averages for the value of total

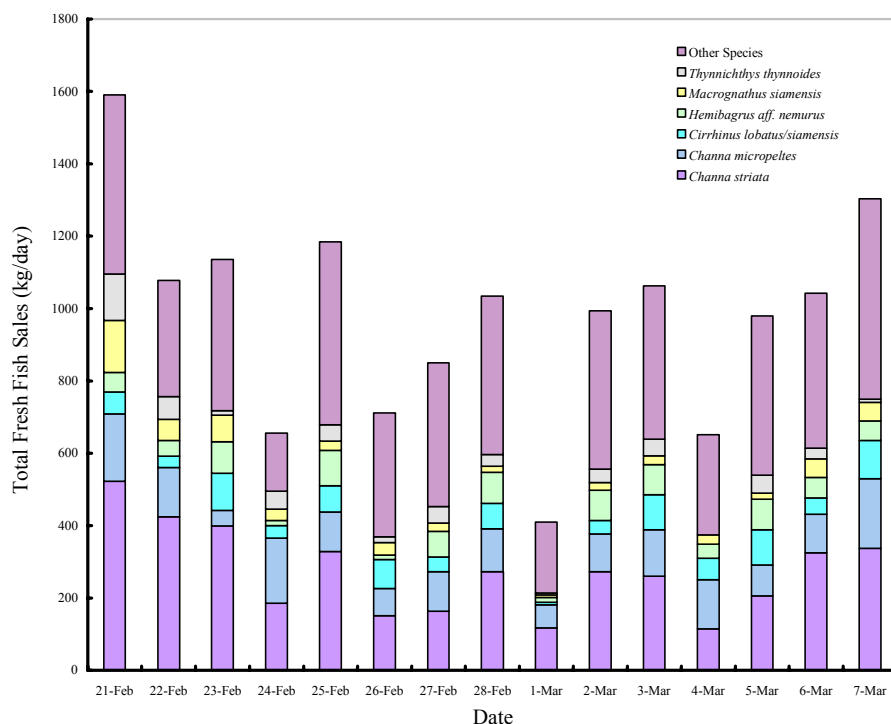


Figure 6. Total sales of inland fish in Bang Keng Kong market over 15 days; showing the six most common species

Table 5. Weight (kg) of fish produce on sale (5-day rolling averages and 15-day mean value) at Bang Keng Kong market, central Phnom Penh

| Mean total weight      | <i>Channa striata</i>  | <i>Channa micropeltes</i> | <i>Trey riel</i> | <i>Hemibagrus aff. Nemurus</i> | <i>Macrogathus siamensis</i> | <i>Thynnichthys thynnoides</i> | Other species | All fish     |
|------------------------|------------------------|---------------------------|------------------|--------------------------------|------------------------------|--------------------------------|---------------|--------------|
| Day:                   | <b>Rolling Average</b> |                           |                  |                                |                              |                                |               |              |
| 1-5                    | 372                    | 131                       | 60               | 59                             | 66                           | 60                             | 380           | <b>1,128</b> |
| 2-6                    | 298                    | 108                       | 64               | 51                             | 44                           | 37                             | 349           | <b>953</b>   |
| 3-7                    | 245                    | 103                       | 66               | 57                             | 37                           | 34                             | 365           | <b>907</b>   |
| 4-8                    | 220                    | 119                       | 60               | 56                             | 26                           | 38                             | 369           | <b>887</b>   |
| 5-9                    | 206                    | 95                        | 54               | 56                             | 21                           | 29                             | 376           | <b>838</b>   |
| 6-10                   | 195                    | 94                        | 47               | 53                             | 21                           | 27                             | 362           | <b>799</b>   |
| 7-11                   | 217                    | 105                       | 50               | 67                             | 19                           | 33                             | 378           | <b>870</b>   |
| 8-12                   | 207                    | 110                       | 54               | 61                             | 19                           | 30                             | 354           | <b>830</b>   |
| 9-13                   | 194                    | 103                       | 60               | 61                             | 19                           | 35                             | 355           | <b>819</b>   |
| 10-14                  | 236                    | 112                       | 67               | 69                             | 28                           | 41                             | 401           | <b>945</b>   |
| 11-15                  | 248                    | 129                       | 81               | 63                             | 34                           | 34                             | 424           | <b>1,007</b> |
| Min. of 5-day means    | 194                    | 94                        | 47               | 51                             | 19                           | 27                             | 349           | <b>799</b>   |
| Max. of 5-day means    | 372                    | 131                       | 81               | 69                             | 66                           | 60                             | 424           | <b>1,128</b> |
| 15-day mean (all data) | 272                    | 118                       | 63               | 58                             | 40                           | 41                             | 389           | <b>978</b>   |
| Ratio min/15-day mean  | 0.71                   | 0.80                      | 0.75             | 0.87                           | 0.46                         | 0.67                           | 0.90          | <b>0.82</b>  |
| Ratio max/15-day mean  | 1.37                   | 1.11                      | 1.29             | 1.18                           | 1.65                         | 1.47                           | 1.09          | <b>1.15</b>  |

Notes: *Trey riel* = *Cirrhinus lobatus* and *C. siamensis*. This data was used to generate the bar chart in Figure 6.

fresh fish sold varied between +11 to – 19% of the 15-day mean. Again, this level of variability is probably acceptable for most assessments of the value of produce on sale at markets.

Notwithstanding these conclusions, fuller assessment of possible future monitoring options and survey methodologies requires data sets acquired over longer periods. Therefore, we will continue to monitor individual sellers for a period of one year, and, by sub-sampling the data generated, we hope to compare the results derived from differing sampling intervals and durations.

Table 6. *Total weight (kg) of inland fresh fish sales over a 5-day period (Monday – Friday) in the five of the 'key markets', central Phnom Penh*

| Total weight on day | Chass | Central | Olympic | Oresey | Toul Tom Pong |
|---------------------|-------|---------|---------|--------|---------------|
| 1                   | 425   | 449     | 589     | 679    | 503           |
| 2                   | 470   | 410     | 630     | 633    | 474           |
| 3                   | 628   | 400     | 672     | 596    | 432           |
| 4                   | 590   | 484     | 634     | 674    | 490           |
| 5                   | 623   | 441     | 662     | 627    | 435           |
| Average             | 547   | 437     | 637     | 642    | 467           |
| Min.                | 425   | 400     | 588.5   | 596    | 432           |
| Max.                | 628   | 484     | 672     | 679    | 503           |
| Min/mean (%)        | 78    | 92      | 92      | 93     | 93            |
| Max/mean (%)        | 115   | 111     | 105     | 106    | 108           |

Note: Data collected between 7 April and 16 May 2003.

Data obtained from monitoring carried out at the five other 'key markets' in mid-2003 are summarised in Table 6. These show that only minor variability occurs over a 5-day period. At four of the markets total sales varied by less than 11% and at Chass market by about 20%. No particular day stands out as consistently high or low in any of the markets. These data suggest that even monitoring for as little as one to two days could provide an acceptable indication of the short-term total volume of sales.

Table 7. *Proportional contribution by weight of most common species on sale in the six 'key markets', central Phnom Penh*

| Species (%)                      | Chass | Central | Olympic | Oresey | Toul Tom Pong | 5-market mean | Bang Keng Kong |
|----------------------------------|-------|---------|---------|--------|---------------|---------------|----------------|
| <i>Channa striata</i>            | 9     | 29      | 10      | 33     | 27            | 21            | 28             |
| <i>Channa micropeltes</i>        | 38    | 28      | 13      | 10     | 12            | 20            | 12             |
| <i>Wallago attu</i>              | 4     | 11      | 3       | 9      | 13            | 7             | 3              |
| <i>Hemibagrus aff. nemurus</i>   | 7     | 5       | 6       | 6      | 7             | 6             | 6              |
| <i>Micronema apogon</i>          | 4     | 7       | 7       | 6      | 2             | 5             | 2              |
| <i>Cyclocheilichthys enoplos</i> | 1     | 5       | 8       | 8      | 3             | 5             | 3              |
| <i>Pangasius larnaudii</i>       | 7     | 0       | 6       | 3      | 1             | 3             | 1              |
| <i>Mystus multiradiatus</i>      | 3     | 0       | 3       | 2      | 8             | 3             | 1              |
| <i>Hemisilurus mekongensis</i>   | 1     | 8       | 1       | 1      | 3             | 2             | 2              |
| <i>Parambassis</i> spp.          | 2     | 0       | 4       | 4      | 0             | 2             | 2              |
| Other species                    | 24    | 8       | 40      | 18     | 25            | 24            | 41             |

Notes: Data was collected from all the markets during a 5-day survey recorded between 7 April and 16 May 2003. Additional data was collected from Bang Keng Kong market during a 15-day survey recorded from 21 Feb to 7 March 2003. Total weights are the same as those in Tables 5 and 6

The composition of species in these five markets was also similar to that at Bang Keng Kong; the largest proportion of total sales consisted of snakeheads with a few other species making up the remainder. Differences between Bang Keng Kong and the other markets probably reflect the time of year, or season, when the monitoring took place. *Trey riel* for example, comprised about 6% of sales at Bang Keng Kong but were relatively unimportant (<1% of sales) at the other five markets because large catches are made only during the flood recession from November to February. The two introduced species, the Nile tilapia and the silver carp (*Hypophthalmichthys molitrix*), made up less than 1% of sales.

## DISCUSSIONS AND CONCLUSIONS

This study set out to quantify the retail fish trade in the markets of Phnom Penh, and to present an overview and some preliminary results as a primer for those seeking to carry out similar work in Cambodia or in the Lower Mekong Basin.

We believe that while many important lessons (listed below) learned during the surveys apply mainly to Cambodia they could also be applicable more regionally.

1. Interview a variety of people before monitoring begins to identify the number and type of markets. Document the number and gender of sellers and the types of products they sell prior to selecting the traders to monitor.
2. Offer traders a small incentive to overcome their general reluctance to provide information. Visually verify responses to questions.
3. Traders do not like to be disturbed prior to making significant sales in the morning; they considered it unlucky.
4. Most traders (about 90%) are female, so they may respond best to female interviewers.
5. Raw data (sales quantities) obtained in one-day surveys may be quite inaccurate.
6. Groups of similar species are often recorded as single species; *trey riel*, for example, comprises two main species plus a small proportion of other species.

Monitoring can be carried out on three levels:

1. A one-day survey of the numbers of traders and products in a market provides a good descriptive framework for designing further sampling surveys.
2. Whole market estimates of quantities and prices for each market trader provide complete information, but are time-consuming to obtain. The data in this study showed that the total amounts and composition of sales of inland fresh fish remained relatively stable during short sampling periods. Therefore, short-term monitoring for five days should provide reasonably



representative results.

3. Daily logbook monitoring of individual traders provides long-term data, which, if correlated with whole-market data, can be used to estimate whole-market sales.

However, we carried out this study over a very short period, but ideally, to obtain a truly representative picture, data collection should continue for one year. However, despite its short duration, the study has revealed some important information:

1. Indigenous inland fish are by far the most important component of sales of all aquatic animal foods in the markets of Phnom Penh. This is surprising given the large proportion of ethnic Chinese and Vietnamese who prefer marine species.
2. Snakeheads dominate sales because they are high quality fish that can be brought to market alive. Snakeheads come from three sources: wild-capture, captured and fattened in pens, and aquaculture. Cage culture of snakeheads has increased dramatically over the last few years, because they can be fed low-value fish, especially *trey riel*, so providing one efficient way of attenuating the seasonal flux of fish. Their market value is about three to five times that of *trey riel*, which reflects well the economics of conversion (about 3:1 or 4:1), transport, and sale of live fish.
3. OAAs are sold in relatively small quantities but fetch a relatively high value compared with fish. Their high value suggests that there is considerable scope for increasing their production.

We regard the other features of the data presented in this paper are only indicative until further information becomes available.

In contrast to the situation in developed countries, markets in Cambodia support many small suppliers and vendors, most of whom are self-employed women. Sales are for cash. There is little investment in infrastructure or refrigeration, and most food is fresh and from local sources. Despite this apparently ‘undeveloped’ situation, Cambodian markets continue to deliver a highly nutritious range of fresh foods (fish, meat, vegetables, and fruit) at relatively low prices, so caution should be exercised in any plans to ‘improve’ them or to develop more capital-intensive Western-style supermarkets.

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