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Etymology of Ghoti

George Bernard Shaw (1856-1950), polymath, playwright, Nobel prize winner, and the most prolific letter writer in history, was an advocate of English spelling reform. He was reportedly fond of pointing out its absurdities by proving that 'fish' could be spelt 'ghoti'. That is: 'gh' as in 'rough', 'o' as in 'women' and 'ti' as in palatial.

Near extinction of a highly fecund fish: the one that nearly got away

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Abstract

It is widely assumed that commercial fisheries of highly fecund species are particularly resilient to exploitation, and that, should populations become seriously diminished, economic constraints will force fishing to cease before biological extinction can occur. Indeed, among commercially exploited marine fishes there is not one confirmed global extinction. Here we document, using nonconventional means, a story that not only questions such assumptions but that should also alert us to how little we know about significant fisheries in some parts of the world. Our case study is that of the highly threatened Chinese bahaba, *Bahaba taipingensis*, a member of the Sciaenidae (the drums or croakers), and an example of a fecund and commercially important group of fishes that appears to be especially vulnerable to fishing. We also demonstrate that the careful use of informal, or traditional, information can provide a powerful, sometimes unique, means of identifying and assessing the status and history of species that might be quietly slipping away before we learn anything about them.

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Introduction

There is strong resistance to accepting the idea that marine fishes which produce hundreds, or millions of tiny eggs dispersing into the oceans could ever be at risk of extinction from fishing (Mace and Hudson 1999; Roberts and Hawkins 1999; Hutchings 2001; Sadovy 2001). Perhaps with good reason, for there are no known global extinctions of any marine fishes

due to exploitation (Carlton *et al.* 1999; Dulvy *et al.* 2003). Moreover, since severe population declines amongst commercially important species are often followed by recovery once fishing stops, they tend to be considered the purview of fisheries managers, rather than of conservationists. One apparent exception is the totoaba (*Totoaba macdonaldi*, Sciaenidae), a massive croaker and member of a highly fecund fish family, the Sciaenidae. Despite protection since 1975 on Appendix I of Convention on International Trade in Endangered Species (CITES), however, the only commercial fish to be so listed, this species has never recovered its former numbers (Hendrickson 1979; Cisneros-Mata *et al.* 1995). And, the totoaba may not be so exceptional. We present a second case of threatened extinction in a commercially exploited sciaenid, and identify possible problems in yet other croakers. In doing so, we show that the totoaba is not unique, that high fecundity will not necessarily protect marine fishes from the threat of biological extinction and that the life-history and fishery patterns of many sciaenids make them particularly vulnerable to fishing.

The case we document is the story of a species that could possibly have disappeared but for the chance discovery of its name on a species list, combined with data-gathering approaches that allowed us to piece together its tale. Amongst other things, this example illustrates that the judicious use of informal sources of information could, and perhaps should, be much more widely adopted in fishery assessment, especially in regions where resource monitoring is poor or lacking and there is little or no management.

The case of the Chinese bahaba

In the early 1930s, a new species of giant croaker became known to Western scientists when Herre described the giant yellow croaker, or Chinese bahaba, now known as *Bahaba taipingensis* (Herre 1932, 1935; Lin 1935). "In the markets . . . . . of China I have seen sciaenids a meter or more in length which I am confident belong to undescribed species. Unfortunately, I had no way of preserving them at the time and no small specimens were to be found . . . . . ". At the time, it was unrecorded in the Chinese literature, and like the totoaba, great value lay initially in its swimbladder (for medicinal purposes) rather than in its flesh. Seventy years on, the Chinese bahaba is nearly extinct. In 1988, it was listed as a Grade II State Protected Species in the Peoples Republic of China (PRC). In Hong Kong although it has long since disappeared from local catches, it is not protected and was only noted as commercially extinct in 1997 (Pitcher *et al.* 1998) (Appendix). The increasing rarity of this fish in the last 4 decades came to confer upon it such high value that fishers have referred to it as 'soft gold'; the top retail market value of the swimbladder, weight for weight, exceeded that of gold by up to seven times in 2001.

Using a mixture of unpublished, published and informal sources, we have documented aspects of the biology and fishing history of the Chinese bahaba to reveal a highly fecund species threatened by overfishing and by escalating value with increasing rarity. Its numbers appear to be so reduced that, within one human lifetime of learning of its existence, it may possibly be too late to save it from extinction in the wild. Since the biology and fishery of the Chinese bahaba are virtually undocumented, we used both traditional and scientific knowledge to reconstruct its history (MacKinson and Nottestad 1998; Johannes *et al.* 2000). In 2000 and 2001, we conducted interviews with experienced fishers and traders in Taiping, PRC and Hong Kong, carried out reviews of the English and Chinese literature, newspapers, etc., and communicated directly with academics and government officers in Hong Kong and the PRC (Appendix A1 & A2).

The Chinese bahaba, or giant yellow croaker, is one of the largest of all croakers (Sciaenidae) and has a limited geographical distribution. Like the totoaba it can attain 2 m and exceed 100 kg (Lin 1939; Chu *et al.* 1963; Anderson 1972; Trewavas 1977) (Fig. 1). Its distribution is extremely limited geographically, occurring only within China from the Yangtze River southwards to Hong Kong (Chu *et al.* 1963; Fowler 1972; Trewavas 1977; Cheng 1989; Wu 1991). Catches are reported from the mouths of major estuaries that the species enters seasonally to spawn in large aggregations; the Yangtze River, Zhoushan Is., Min River, and the Pearl River from Hong Kong up to Taiping (Fig. 2). They feed on shrimp, crab and other crustaceans, while sexual maturation occurs at about 13 kg and 35–40 cm total length (Chu *et al.* 1963; Wu 1991). After spawning, adults move out to deeper waters and juveniles may be found in estuarine and coastal areas.

A modest, but valuable, fishery for the Chinese bahaba existed for decades, although the species is uncommon in the Chinese ichthyological literature and there is no fishery monitoring. Catches were highly seasonal, during summer and autumn to the north, and November–April to the south in

Figure 1 Largest known fresh specimen of *Bahaba taipingensis* (>2 m) caught on 30 December 1993, outside Castle Peak Bay, western Hong Kong, as incidental trawler by-catch. The species has yellow lips (a Chinese common name is the yellow-lipped croaker *Huang Chun Yue*) and a distinct black spot above the pectoral fin base. Photo donated by Mr Cheng Tai-sing.

Guangdong Province especially around rocky islands (Chu *et al.* 1963) (Appendix A1). In areas of western Hong Kong, croaker aggregations (several species) were important in 1960s: "In February and March occurs the peak run of the giant croakers *Nibea diacanthus* and *Bahaba flavolabiata (= taipingensis)*. Trawlers set their nets and charge dead into the immense schools of these fish, making incredible hauls" (Anderson 1970). Also referring to these two giant croakers: "Trawls of tons (sic) are not unknown; boats have made $30 000 (Hong Kong dollars (HK$) – see Appendix A2) in a single haul. They are the mainstay of the trawlers." (Anderson 1969). Several gears were used, including specialised nets (*Ting Ji*) of mesh size 36–40 cm and length 90 m (Appendix A1). Fish were located by their drumming sounds, produced by muscles vibrated against the swimbladder, by listening closely against the hull of the boat, particularly between mid noon and midnight. Greatest catches were taken in the weeks prior to full and new moons with up to 300 fish taken in a season. During 1950–1960s in Hong Kong alone, 30–40 boats, specialising in catching the two giant croakers, were active annually (Appendix A2).

Estimates of landings from the three estuaries clearly suggest heavy declines over the last 4–6 decades (Fig. 3). In Hong Kong of the late 1930s, an estimated 50 tonnes were landed annually, dropping to approximately 10 tonnes by 1950s and 1960s, with most fish taken between 12 and 40 kg and only the rare individual of over 80 kg (Lin 1939). By 1990s, only small fish (<30 kg) were taken sporadically,

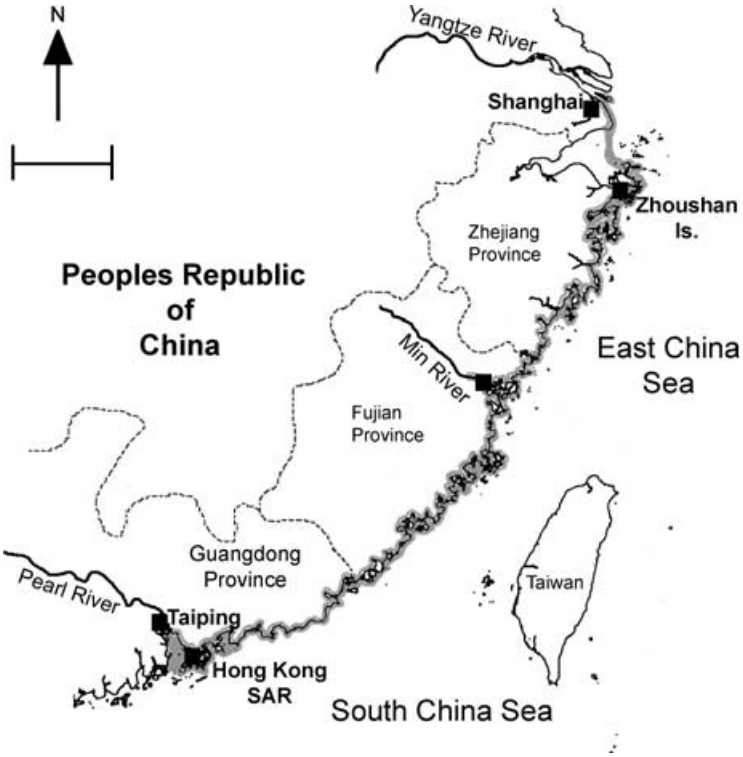

Figure 2 Limited geographical distribution (shading) of *Bahaba taipingensis*. Its fishery was concentrated on spawning aggregations that formed in major estuaries (■). Juveniles are also noted from Taiping and occasionally from along the coast near estuarine areas. Main fishing areas in Hong Kong were in western waters at Castle Peak and Tai O. Scale bar is 150 km.

and large individuals (>50 kg) had become rare. A similar pattern after 1960s was noted elsewhere; prior to 1980s, total PRC landings (not including Hong Kong) did not exceed 10–20 tonnes annually (Hui 1987), with 5–6 tonnes in Zhejiang Province (Wu 2001) in 1950s and 1960s. Early catch data for the Min River were not available but 80 larger fish a year were not uncommon (Appendix A2). Catch information (date, place and weight) of all large fish taken in recent years is available for such catches and are considered to be significant events, widely known to people locally or reported in local newspapers. Single dried swimbladders turn up at private auctions and even for sale on the Internet (Appendix A2).

The swimbladder (maw) of this species is highly appreciated for its medicinal properties and as a general tonic for health (Lin 1939). Swimbladder's price depends on its age and shape, sex and size of fish, and even on the place and season of capture (Lin 1939). Its market value (per kg) has increased from little more than a few US$ in the late 1930s, to anywhere between US$ 20 000–64 000 in 2000–2001 (Lin 1939; Chu and Wu 1985) (Fig. 3). Swimbladders of large individuals were sold in Macau and the PRC, or exported to Thailand (Appendix A2); those of small fish (<5 kg) are evidently little valued.

There is little doubt that the Chinese bahaba is critically reduced and may well be threatened with extinction throughout its limited geographic range, unless significant populations persist offshore. But the latter is unlikely given an apparent dependence on spawning in or close to estuarine areas, and continuing efforts to catch this species during its spawning season. For example, despite catch declines to an estimated 1% of 1960 levels, in the 1990s Taiping fishers with approximately 100–200 boats continued to target the valuable bahaba (Appendix A2). Moreover, the region is one of the most heavily exploited in the world, leaving few, if any, refugia where such a species can persist unexploited.

The demise of this species has likely been driven by its inherent biological vulnerability (large size, restricted geographic range and aggregating behaviour in and around estuaries often involving sound production that makes individuals particularly easy to find), overfishing, absence of management and escalating value. It represents the first marine food fish of extreme conservation concern in SE Asia. It is protected in the PRC, but not in Hong Kong where fishery management is not practised. While the possible role of other factors in the decline of this species, such as degradation of, or changes to, estuarine habitats is not known (this was important in the case of

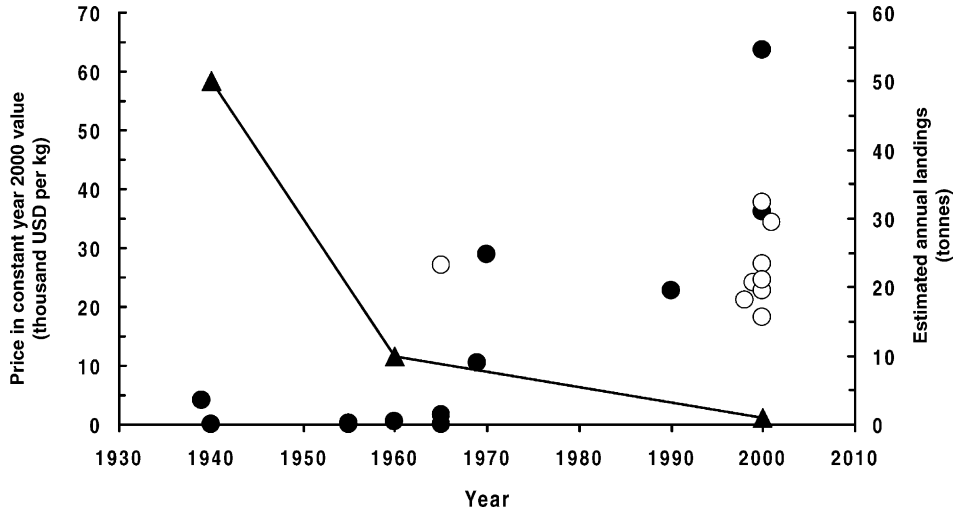

Figure 3 Swimbladder market prices and estimated annual landings of *B. taipingensis* in Hong Kong and elsewhere in the PRC from 1939 to 2000. Swimbladder market prices in HK (●) and elsewhere in the PRC (○) (see additional details in Appendix A2) were estimated and Renminbi (RMB) converted to HK dollars (HK$) (Census and Statistics Department [C & SD], HK government). Prices were first standardised to HK$ values at year 2000 using the Consumer Price Index (from 1975 to 2000), General Consumer Price Index (from 1965 to 1974, C & SD) and wage comparisons before and after 1965 (Hong Kong Government 1939–65; Cowitt 1984). In 1983 the HK$ was pegged to the US$ at approximately 7.8 : 1 US$, while before that, the exchange rate ranged from 4.8 : 1 to 6.5 : 1 US$. Landings (solid line and triangles) were estimated from published accounts and fisher interviews (Lin 1939; Anderson 1970, 1972; Hui 1987; Appendix A2). Landings from the late 1930s were estimated from swimbladders of which about 318 kg (dried weight) were produced in HK annually; the conversion factor between dried swimbladder weight and wet fish weight is 0.00625, indicating landings of approximately 50 tonnes annually for average-sized fish in the fishery of 23 kg fish. Assuming that *B. taipingensis* made up 50% of the giant croaker landings (Lin 1939) these were conservatively estimated from the fishery profile at 10 tonnes annually, consistent with independent published accounts. PRC landings of *B. taipingensis* followed a similar decline after 1960s. During the Cultural Revolution, landings in Taiping averaged 6 tonnes annually, as calculated from stored swimbladder weights (600 kg stored swimbladder converted at a factor of 0.01) (Appendix A2). Everywhere, accounts indicated that catches diminished gradually after 1960s until only the occasional, generally small, fish was caught in 1990s.

the totoaba; Cisneros-Mata *et al.* 1995) fishing pressure, both targeted and indirect (such as the impact of bottom-trawling on juvenile fish and their habitat), has almost certainly been the major single contributory factor in its decline.

The Chinese bahaba is not alone

Among sciaenids, it may not only be our Chinese bahaba that is in trouble in the western Pacific. There are indications that other croakers are particularly vulnerable to overfishing. Yet, like bahaba, there is little information available or being collected for many large and potentially vulnerable species, despite considerable fishery expansion in the region over the last 10 years. The second giant croaker taken in large numbers in 1960s Hong Kong, along with the Chinese bahaba, *Protonibea (=Nibea) diacanthus*, is no longer significant in the region. Although broad in distribution, its status elsewhere is unknown or the fishery has disappeared (e.g. the Gujarat–Maharashtra coast of India, James 1994). The greater yellow croaker, *Pseudosciaena crocea*, a species much appreciated for the quality of its flesh, and once a major fishery in China and Hong Kong, has been severely reduced throughout its limited geographic range since the mid-1980s (Chu 1960; Kawasaki 1987). A paper published in 1960 suggested that this species possibly affected the livelihoods of 10 000 Hong Kong fishermen, occupied about one-third of their fishing time, and was taken at sizes ranging from 18 to 65 cm. Fish were located by the sounds that they produced while aggregating and were caught with several different types of gear, including dynamite (Chu 1960). Since 1950s, landings have plummeted and only the occasional small fish is now taken in Hong Kong, formerly the largest fishery for this species in southern China (Chu 1960; Chong 1984; Pitcher *et al.*

1998; Cheung 2001). Remarkably, most *P. crocea* on sale nowadays are probably produced by full-cycle (i.e. hatchery based) mariculture. Mariculture production was about 18 000 mtonnes in 1999 (when 300 million fry were produced), compared to recorded capture fishery values of considerably less following a stock collapse in the late 1980s (Wang *et al.* 2001; Hong and Zhang 2002). The yellow croaker, *P. polyactis*, has likewise declined precipitously, and the black croaker, *Atrobucca nibe*, has all but disappeared from the region, as far as we have been able to determine (Kawasaki 1987).

Not only are croakers in trouble in the western Pacific and SE Asia, but elsewhere there is concern for other sciaenids. The CITES listed totoaba, endemic to the Gulf of California, has already been mentioned. Three species of croaker, the Gulf corvina *Cynoscion othonopterum* (like the totoaba limited to the Gulf of California), blue croaker *Bairdiella batabana*, and striped croaker *B. sanctaeluciae* were all recently listed among 82 species considered to be vulnerable to extirpation in North American waters by the American Fisheries Society (Musick *et al.* 2000). Two of the five main food finfishes in the Middle Atlantic region 25 years ago were croakers, the weakfish *Cynoscion regalus* and Atlantic croaker, *Micropogonias undulatus*, but both have shown major declines since then (HcHugh and Conover 1986). In Europe, the shade-fish or meagre, *Argyrosomus regius*, which can attain over 2 m in length, was once important and highly valued. It now appears to be severely reduced throughout much of its range (Quero 1989; British Museum Life Study Society homepage). In South Africa, the South African dusky kob, *Argyrosomus japonicus*, which can attain 75 kg and spawns in concentrated spawning aggregations, is also much depleted (Griffiths 1996, 1997).

A pattern of vulnerability

Why should this generally fast-growing and fecund group of fishes be so vulnerable to fishing? Many species are limited in their geographic distributions, some are endemic, and many are largely confined to heavily exploited coastal waters where there are probably few remaining refuges from fishing. Some are targeted when they aggregate to spawn in estuaries where they are relatively easy to find in time and space. They are especially easy to locate if they produce sound during spawning aggregations; indeed, SE Asian fishermen are known to target aggregations nowadays using passive sonar gear (Mok and Yu 2002). Formally, an ear to the hull would have sufficed. The flesh or swimbladder of some are often highly appreciated, making them valuable as food or medicine, while yet other species are important for recreation. Moreover, the close association of many species with estuarine environments poses its own set of challenges and threats; estuaries suffer from degradation and pollution, either directly, or indirectly from effects well inland, while heavy, uncontrolled trawling might seriously damage nursery grounds and remove excessive numbers of juvenile fish (Musick *et al.* 2000). Clearly, the suite of biological, ecological and fishery characteristics that typify many species of croaker make them especially susceptible. Given our limited understanding of many exploited species in this family, closer attention to their monitoring and management is strongly warranted.

In praise of alternative data-gathering

This study demonstrates that informal or traditional knowledge from local and regional experts can be invaluable for understanding the status of aquatic species or reveal details of a fishery where published information is scant or absent (Johannes 1981; Johannes *et al.* 2000). Importantly, much of this information may soon be lost; in our own case study, many of our most knowledgeable informants were well past retirement age while many younger fishers and government fishery officers in Hong Kong were unaware of the giant croakers. Historical data are frequently lacking in fisheries, particularly in developing parts of the world where fishery resources may already have been severely depleted. The complementary use of scientific data and traditional or informal knowledge, as applied in this case study, can facilitate understanding of current status and history of a fishery, as well as inform on behaviour, ecology and abundance of a species (MacKinson and Nottestad 1998; Neis *et al.* 1999). Such an approach to data gathering is often considered imprecise or qualitative. However, methodical collection of data from a wide range of sources, combined with cross-referencing of that material or the use of innovative expert knowledge models (MacKinson 2000), can provide powerful indicators for formulating management action or triggering further scrutiny. Indeed, such approaches may be the only means of understanding a fishery history or condition in some areas. We suggest that local informal knowledge could, and should, be applied more widely to evaluate resource

status, especially in the absence of any relevant information, and particularly for species that might be vulnerable to fishing and that receive no protection or are little monitored.

Concluding comments

The example of the Chinese bahaba demonstrates that neither high fecundity nor increasing rarity necessarily protect marine fishes from critical depletions, and, potentially from extinction. There are telling parallels between this species and the disappearance of the barndoor skate, *Raja laevis* (Casey and Myers 1998). Both species are large and obvious, giants within their respective families, yet little known and particularly vulnerable to the direct and indirect effects of trawling. Neither appear to have access to refuge areas any longer. There are, of course, important differences between these species, one being that of fecundity, the other of value in the fishery, suggesting that neither factor necessarily confers protection from overfishing. Croakers tend to be highly valued, whereas the skate was an unavoidable component of by-catch, while the skate and croaker lie at opposite extremes of the scale of fish fecundity. These differences are significant inasmuch as high fecundity is often assumed to confer resilience relative to less fecund species, while declines in catch per unit of effort will not stop fishing if cash per unit of effort increases with rarity. There is clearly good reason to challenge both assumptions (e.g. Hutchings 2001; Sadovy 2001).

The case of the Chinese bahaba, and several of its relatives, highlights the need to identify suites of vulnerable characteristics as a means of prioritizing management and conservation action, as well as the value of nonconventional means of data gathering. Once sufficient information has been gathered, recommendations can be formulated. In this case, we would propose the seasonal protection of aggregation areas and of inshore nursery grounds, to reduce trawling pressure, and/or to prohibit excessively efficient fishing especially the use of passive sonar gears during spawning seasons (Mok and Yu 2002). Mariculture has also been recommended as one possible solution to the demise of the Chinese bahaba (Hong and Zhang 2002). As long as informal and traditional knowledge sources are well-documented and carefully corroborated, they can provide valuable insights into fishery history, status and possible solutions, often obtainable in no other way (Johannes 1998). It seems unthinkable that distinct and massive species, like the Chinese bahaba, could slip away before we came to learn anything about them; this one almost did.

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Appendix A1

Fishing methods/operations used for catching Chinese bahaba according to interviews with fishers and traders[1]

Fishing method	Gear description	Fishing operation	Information source
'Ting Ji' net (major fishing method in Hong Kong). This gear was specifically used for this species	During the Chinese bahaba fishing season (November–April), five nets of mesh size 36–40 cm, 11–13 m in depth and 18 m in length were joined together end-to-end. Two small boats (sampans, about 4.5 m in length) and one mother boat (18–21 m in length) and at least 10 fishers were involved in one fishing operation, with 2–3 fishers on the mother boat and 3–4 fishers per small boat.	Fishing usually started at 04 : 00–05 : 00 hours and ended at 23 : 00–24 : 00 hours. Skilled fishers could locate precisely the shoal, and determine approximate fish and shoal size by listening to fish drumming sounds at the boat's hull. On locating a shoal, the two sampans would set the net, then sail forwards to enclose the located shoal. Water was beaten by a special bamboo tool to prevent fish escape, and catches hauled to the mother boat.	Mr Leung Tai-zhen, Castle Peak Bay Fishers (7 and 14 July, 2000).
Gillnet (major method in Hong Kong)	Gillnet of mesh size 20–30 cm, 1.5–3 m in height with 10–30 nets joined together end to end. Only one fishing boat (about 6 m in length) was used.	Fishers fished both day and night during the Chinese bahaba season. Best fishing times were the 12th and 13th, and the 26th and 27th nights of the lunar calendar (days prior to new and full moons). During daytime, nets were set in suitable water currents. At night, fishers would locate shoals by their drumming sounds. Once located, they sailed the boat towards the shoal, then set the net perpendicularly to its down-current side.	Ah Pak, Mr Ng, Mr Wen Ying-fai and an anonymous fisher, Tai O (5 September, 2000).
Hook and line (recreational)	Live cuttlefish as bait.		Mr Patrick S.W. Chan (Brightfuture Ltd., Hong Kong) 12 September, 2000.
Taiping, Peoples Republic of China (PRC): gillnet, long-line, shrimp trawl, pair trawl	Gillnet of 5 m height and 3740 m in length. Long-line of 5–10 km with hook every 8–10 m. Shrimp trawl 6 m in circumference. Pair trawl 120–140 m in circumference.		Taiping fishers (4) and trader (1); interview and visit arranged by Mr Chan Mau-wing, Director of Fisheries Department, Taiping; translated by Ms Liu Min, Department of Ecology & Biodiversity, the University of Hong Kong (27 September, 2000).

[1]Interviews were conducted and translated by William Cheung, unless otherwise indicated. Note that original reported currency and weight units are provided (in parentheses) along with metric/US$ conversions to current day values. See also Fig. 3.

Appendix A2

Estimates of Chinese bahaba landings/value at major fishing centres in Hong Kong and Peoples Republic of China (PRC) from 1930s to 2001

Year	Location	Landings/value[2]	Information source
Late 1930s	Hong Kong	Annually to 50 tonnes[3].	Lin 1935
1938	Guangdong Province, PRC	Abundant fish of 30 cm, November–January	Lin 1939
1950s	Hong Kong	Large swimbladder 46 cm (18 in.) sold for US$ 5217 (HK$ 30 000) from fish >60.5 kg (>100 catty). Interviewee stated that he had not seen the species in 30 years but has heard that it occasionally (in the 1990s) turns up at secret traders' auction. Interviewee says fish is extinct but does not know why; also notes that another croaker (*Nibea albiflora*) has become rare.	Ah Pak, Tai O fishery, 5 September 2000. Mr Wing-kei, Hop Lee Ho – dried seafood importer/exporter Des Voeux Road, Hong HK Kong 16 November, 2000; translated by Mr Kwan Sai-ping Worldwide Fund for Nature, HK.
1950s to 1960s	Hong Kong	Fish occasionally seen in local markets but few were large; 2–4 fish seen over several months of the year, each up to 120 kg. Many boats fished for Chinese bahaba during the season with 30–40 specialised for the purpose. *Premechanisation*: Tai O fishers maximum catch per haul noted was 29 smaller fish, weighing 12–40 kg (more typically 18–24 kg); usually 3–8 fish per haul with approximately 1–2 hauls per day of 'Ting Ji' (see above) or croaker seine; few large fish (60–200 kg) per haul. *Postmechanisation*: could be 100 fish per day at Tai O under favourable conditions but highly variable. Catches increased with improved nets and methods and fishers could get up to 1000 fish per haul of giant croakers (2 species) of which about 50% were *Bahaba taipingensis* (Lin 1939) but more typically 0–300 per season (January–April). Total annual landings conservatively estimated (by us and from data provided) at 10–20 tonnes. Not uncommon to find fish of 80 kg though some smaller and a few reached 100 kg. Prices US$ 5.69–14.31 (HK$ 33–83) kg^{-1} of swimbladder.	Mr Wen Ying-fai, Mr Ng, and an anonymous fisher (5 September 2000); Ah Pak (5 September 2000), Tai O fishers; Mr Leung Tai-zhen, Castle Peak Bay fisher (7 and 14 July 2000).
1969		US$ 10 or more per swimbladder and up to US$ 1000 for a single bladder or US$ 22.68–2356.6 (HK$ 110–11 029) kg^{-1} swimbladder.	Anderson (1972)

Appendix A2 continued

Estimates of Chinese bahaba landings/value at major fishing centres in Hong Kong and Peoples Republic of China (PRC) from 1930s to 2001

Year	Location	Landings/value[2]	Information source
1950s to 1960s	Zhoushan Island (sold at Shanghai market), Zhejiang Province, PRC	Annual catch about 5–6 tonnes, summer and autumn. Swimbladder at US$ 0.09–0.2 kg^{-1} (HK$ 0.5–1.16 kg^{-1}) for the whole fish, and up to US$ 8.76–14.01 kg^{-1} (HK$ 50–80 kg^{-1}) for swimbladder only. Swimbladders were each worth <US$ 54.34 (< RMB 100) and were considered to be relatively cheap in 1950s. In China (Zhuhai inshore waters) in 1950–1960s, Chinese bahaba of >60.5 kg (>100 catties) were observed. Since that time, interviewee (although no longer fishing) mainly saw smaller fish, on average 78.65–84.7 kg (130–140 catties), while bigger fish of 96.8–102.85 kg (160–170 catties), up to biggest of about 109 kg (180 catties), were uncommon. Swimbladders once sold in Macau but fish flesh not considered good eating. Used to catch one fish per 10 days in the Chinese bahaba fishing season.	Wu, Han-lin. Professor of Ichthyology, Shanghai Fisheries University, Director Fisheries Laboratory, Shanghai (in litt. May and June, 2001). Wu 2001. Mr Kwan, Yuk-shue (interviewed by Mr Kwan Sai-ping, – his son), late 2000.
c. 1960	Hong Kong	Fish swimbladder 40 years ago was generally priced around US$ 14.5 kg^{-1} (HK$ 50 per catty[4]) but prices were much higher for the Chinese bahaba for which a large swimbladder retailed at US$ 2712 kg^{-1} (HK$ 800 per tael[4]).	Mr Mak (trader), C. P. Hop Lee Ho company, dried seafood trader Des Voeux Road, Hong Kong. Interview 16 November, 2000, translated by Kwan Sai-ping Worldwide Fund for Nature-HK.
1960s and 1970s	Taiping, Guangdong, Province, PRC	In March–April production was high and stable; less than 100 boats were involved in the fishery. Incidentally taken by trawlers (fish of 2–4 kg); might have exceptional catches of single fish up to 130 kg. Over 10 years, a minimum of 60 tonnes taken (calculated from swimbladder weights; the bladders were stored during the Cultural Revolution and the conversion factor was 1% as indicated by Taiping fishers as the value to use); catches variable from year to year and both juveniles and ripe adults taken. The fish can grow to 1.25 kg and 26 cm in their first year and 2.5 and 5 kg in the second and third years. Spawn in February–May and were often taken for a concentrated period in April at Taiping. A 70-kg fish has a 14-kg ovary. After spawning, adults migrate to deeper water and juveniles stay around Taiping. The fish mainly spawn 4–10 days after new moon and before full moon. US$ 1087 (RMB 2000) kg^{-1} of swimbladder.	Taiping fishers and trader; interview and visit arranged by Mr Chan, Mau-wing, Director of Fisheries Department, Taiping, PRC; translated by Ms Liu, Min, Department of Ecology and Biodiversity, the University of Hong Kong (27 September 2000).

Late 1960s	Shanghai market, Zhejiang Province	Only occasionally seen, few large fish.	Professor Wu, Han-lin (see above).
1970	Hong Kong	US$ 2062 (HK$ 10 000) per swimbladder and US$ 3409 (HK$ 16 535) kg^{-1} swimbladder. One swimbladder 30 years ago cost US$ 2062 (HK$ 10 000). Seasonality in Chinese bahaba appearance for sale. Average fish size 30 years ago was 265–331 kg (160–200 catties) in local markets. Had not seen this species for 30 years. In season, often 3–4 fish available but never common. Not sure of source of swimbladders he purchased. Largest he saw was 496 kg (300 catties) and he estimated our photo to be a fish of 265–331 kg (160–200 catties). Swimbladders were brought in by local fishers. Some went for export.	Mr Yeung (trader), Hop Lee Ho Company (interview 16 November, 2000). Des Voeux Road, translated by Mr Kwan Sai-ping Worldwide Fund for Nature-HK.
1970s and 1980s 1976	Hong Kong	Catches diminished gradually but markedly. Reports instances where he, as a recreational fisher, has seen the fish. Swimbladder important for miscarriage problems. In July 1976, caught 2 m fish in western Hong Kong; swimbladder was 0.91 kg (1.5 catties and 18 in. long). Used to be an important species for trawlers in western waters and easy to find in 1970s in markets of Tai O but hardly any in local markets for past 15 years.	Mr Wen Ying-fai, Mr Ng, and an anonymous fisher (5 September, 2000); Mr Ah Pak (5 September, 2000), Tai O fishers; Mr Leung Tai-zhen, Castle Peak Bay fisher (7–14 July, 2000). Mr Chan, W. L (ex Hong Kong government Fishery Officer), interviewed May, 2001 Mr Patrick S.W. Chan (Brightfuture trading), pers. comm. 12 September, 2000.
1980s	Zhoushan Is, Zhejiang Province (Shanghai market)	Occasional individual caught, rare in market. One large swimbladder from a fish caught in Zheijiang in 1980s was being sold on website in 2001 for about US$ 64 000.	Professor Wu, Han-lin (see above). Website of Mr Cheung Lam http://www.nease.net/~chensong/(In Chinese) accessed June, 2001 – translation in footnote[5] Chong (1984)
1983–84	Hong Kong	Fishery Department demersal monthly fishery survey caught 1 fish of 16.7 kg in south-eastern Hong Kong, December 1982.	
mid-1980 to early 1990s	Fujian and Guangdong Provinces, PRC	Production dropping to low, occasionally taken in deep waters at Xiamen, Dongshan Dao; small fish (20–35 cm TL) occasionally found at mouth of Min river, Zhujiang Kou, and Taiping County during a national fishery survey conducted from 1985 to 1989. Min River was historically an important fishery with up to 80 fish of 12.1–24.2 kg (20–40) each and 40–60 cm TL, maximum 1 m. Some exported through Hong Kong to Thailand. Min River, 3 years ago, just 10 fish taken. Value of a (100 catty) 60.5 kg fish and 1 m long about US$ 23 895 (RMB 200 000) in 1990s[6].	Mr Huang Lu-zhou, Fujian Fisheries Department Fuzhou (pers. comm. 19 March, 2001). States that little literature available but due to high value some research will go into studying this species.
1990	Hong Kong	US$ 13584 (HK$ 105 822) kg^{-1} of swimbladder.	Mr Cheng, Tai-ngan, Cheung Chau fisher (22 August, 2000).

Appendix A2 continued

Estimates of Chinese bahaba landings/value at major fishing centres in Hong Kong and Peoples Republic of China (PRC) from 1930s to 2001

Year	Location	Landings/value[2]	Information source
1990s	Taiping, Guangdong Province, PRC	Few fish caught in last decade, most >50 kg are considered a special event. About 20 fish caught in total over the last few years, mostly small (<30 kg), a few up to 70 kg. 100–200 boats seek the species each year but catch has declined to about 1% of 1960s production. In 1998, 6 fish totaling 300 kg fetched US$ 71 685 (RMB 600 000) (=RMB 200 000 kg^{-1} swimbladder). In 1999 two fish weighed 130 kg and sold for US$ 33 453 (RMB 280 000).	Taiping fishers and trader; interview and visit arranged by Mr Chan, Mau-wing (see above); translated by Ms. Liu Min (see above).
1990s	Fujian and Guangdong, PRC	Rare, the occasional large swimbladder turns up at private auctions. A few fish are caught every few years, mostly small, despite high fishing effort. Largest recently was a 60-kg fish.	Mr Huang Lu-zhou (see above).
1990s	Hong Kong	In Tai O 2–3 caught a few years ago; largest was 60 kg, none taken in 2000.	Mr Wen Ying-fai, Mr Ng, an anonymous fisher, Mr Ah Pak (5 September, 2000), Tai O fishers
2000	Southern PRC	US$ 19324 (RMB 160 000) kg^{-1} of swimbladder	Professor Wu, Han-lin (see above).
	Fujian, PRC	US$ 39939 (RMB 330 694) kg^{-1} of swimbladder (=RMB 2000 per catty).	Mr Huang, Lu-zhou (see above).
2000	Taiping, Guangdong Province, PRC	In 2000 in Taiping, on separate occasions, prices were: US$ 14 493 (RMB 120 000) per 50 kg fish (=240 000 RMB and US$ 28 986 kg^{-1} of swimbladder); 20 fish weighed 500 kg and were valued at US$ 24 155 (= RMB 1 000 000, equivalent to RMB 200 000 kg^{-1} swimbladder). Eight fish weighing 150 kg sold for US$ 36 232 (RMB 300 000, equivalent to RMB 200 000 kg^{-1} swimbladder).	Taiping fishers and trader; interview and visit arranged by Mr Chan, Mau-Wing (see above); translated by Ms. Liu, Min (see above).
2000	Hong Kong	US$ 21 795 per swimbladder (HK$ 170 000); HK$ 300 000 per catty of swimbladder (=HK$ 496 041) and US$ 63 595 kg^{-1} of swimbladder.	Hong Kong trader talking to Mr Kwan Sai-ping, late 2000.
2001	Zhejiang, PRC	One fish 1.5 m and 66.5 kg sold to Taiwan at US$ 24 155 (RMB 200 000) – reflecting the price of the swimbladder (newspaper article).	Mr Au Wing-kei, seafood trader Newspaper article – San qin du shi bao, Zhejiang, 24 March, 2001 (In Chinese) translation in footnote[7,8]
	Min River, PRC	One 100-kg fish retailed at approx. US$ 26 000 (RMB 200 000)	Mr Min (father of Ms. Liu Min).

[2]Currency conversions: 1 : 5.7–1 : 5.8 US$:HK$ in 1950s and 1960s; 1 : 5.71 US$:HK$ in 1954; 1 : 4.85 US$:HK$ in 1974; 1 : 1.84 US$:RMB in 1974; 1 : 8.37 US$:RMB in 1990s; 1 : 8.28 US$:RMB in 2001.

[3]Fish weights/prices, unless otherwise indicated, were calculated from swimbladder weights assuming that the swimbladder is about 0.625% of total wet weight for an average fish size 23 kg (Lin 1939).

[4]Conversions of weights: 0.605 kg = 1 catty = 16 taels.

[5]The giant yellow croaker (Chinese bahaba) is caught from the East and South China Seas. However, since 1960s, the fish has disappeared from local catch. As a valuable Chinese medicine, the swimbladder of the giant yellow croaker is very expensive. A giant yellow croaker swimbladder of 43 cm in length, 370 g in weight, from a fish caught in mid 1980s along the coast of Zhejiang (PRC) was kept. The swimbladder was then preserved and it is proven that this giant yellow croaker swimbladder is the largest ever found in PRC. The price for this swimbladder is RMB 500 000, and anyone who is interested to buy it can contact Mr Cheung Lam at e-mail: linzhangnj@hotmail.com.

[6]200 000 RMB buys a three-bedroom house in Fujian Province in the late 1990s.

[7]Last week, a globally rare large size giant yellow croaker was brought by Rui an shi xing long frozen company for more than RMB 200 000 from a Taiwan fisher from the Formosa Strait. The fish is of 1.5 m in length, 66.5 kg in weight, golden in colour. Some local experienced fishers said that they had never seen this fish. Giant yellow croaker (Chinese bahaba) and yellow croaker belong to the same family, the swimbladder of the prior species is a valuable medicine. Its price is three times that of gold. It is estimated that the value of the swimbladder of this giant yellow croaker can be up to RMB 200 000.

[8]Sadovy, Y. and Cheung, W.-L. (2001) The case of the disappearing croaker, the Chinese bahaba, *Bahaba taipingensis*. Porcupine! Newsletter of the Department of Ecology & Biodiversity, University of Hong Kong, December, 2001, Number 24: 14–15.