

## Understanding pressures on fishery resources through trade statistics: a pilot study of four products in the Chinese dried seafood market

*Shelley Clarke*

Renewable Resources Assessment Group, Imperial College London, Royal School of Mines Building, Prince Consort Road, London SW7 2AZ, UK

### Abstract

This study investigates the dried seafood trade, centred in Chinese markets, in order to better understand the pressures its demand exerts on global marine resource stocks. Using Hong Kong, the region's largest entrepôt, as a focal point, the trade in shark fins, abalone, bêche-de-mer and dried fish is characterized in terms of product history, volume, source fisheries and species composition. Trends identified in the Hong Kong market are interpreted in the context of the larger Chinese market. Shark fin imports grew 6% per year between 1991 and 2000, most likely because of market expansion in Mainland China, posing increasingly greater pressures on global shark resources. In contrast, the quantities of dried abalone traded through Hong Kong remained steady, but inferences based on this trend are discouraged by suggestions of increasing preferences for fresh product forms and growing domestic production in Mainland China. Hong Kong's imports of dried bêche-de-mer (sea cucumber) have decreased, while the percentage of imports re-exported has remained steady, suggesting that Hong Kong continues as an entrepôt for Mainland China despite declining domestic consumption. Few conclusions can be drawn regarding dried fish products, including whole fish and fish maws, because of a lack of product differentiation in customs data, but a market survey was conducted to provide information on species composition. Comparison of Hong Kong dried seafood trade statistics to those of other key trading partners indicates that, in general, Hong Kong's duty-free status appears to encourage more accurate reporting of traded quantities. Under-reporting biases ranged from 24 to 49% for shark fin and bêche-de-mer, respectively. Comparison to United Nations (UN) Food and Agriculture Organization (FAO) databases indicates additional under-reporting for shark fin such that an alternative minimum estimate of world trade is at least twice the FAO estimates in 1998–2000. The results of a survey of Hong Kong traders provide insight into their attitudes toward harvest, economic and regulatory factors, and suggest that conservation efforts are unlikely to emerge from, or be actively supported by, dried seafood trade organizations. The market's apparent sensitivity to economic sentiment, however, reveals an opportunity for consumer education to play a role in shaping future market growth and resource conservation. Recommendations are provided for improving trade statistics and for developing better analytical techniques to complement traditional methods for monitoring the exploitation and management of fisheries resources.

**Correspondence:** S. Clarke, National Research Institute for Far Seas Fisheries, 5-7-1 Shimizu-Orido, Shizuoka 424-8633, Japan  
Tel.: +81 543 36 6046  
Fax: +81 543 35 9642  
E-mail: sclarke@fra.affrc.go.jp

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## Introduction

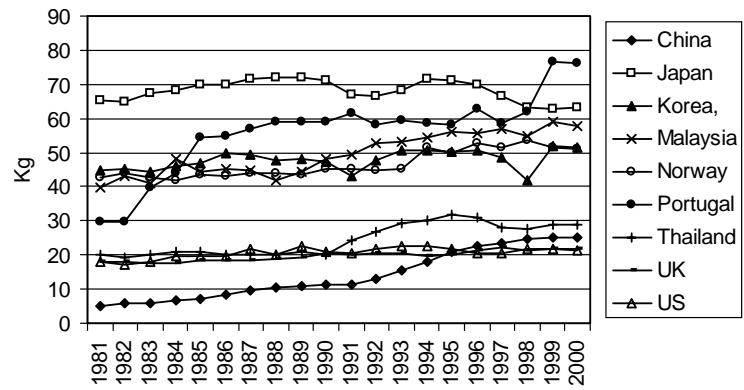
In the absence of reliable catch statistics, collection and analysis of market data for fisheries products can provide a useful means of identifying source populations and tracking relative extraction rates over time (Birstein *et al.* 1998; Lack and Sant 2001; Dalebout *et al.* 2002). Market-based studies also have the advantage of providing insight into the behaviour of traders (used in this study to refer generally to importers, wholesalers and/or retailers) and consumers. Understanding this behaviour allows more informed projection of future trends as well as identifies areas where influence can be exerted through, for example, enforcement, labelling or education. While trade assessment may never be a substitute for traditional resource management tools (e.g. Hilborn and Walters 1992; Haddon 2001), it can provide a vital supplement to existing fisheries management systems by warning of declines in marine resources not well documented in catch statistics.

Innovations of recent decades in food processing technology, improvements in cargo transport and incentives towards an increasingly globalized economy have radically transformed the world's seafood trade (Parfit 1995; Reid 1995). In most of the developed countries, distinctly local seafood products reflecting

regional supplies and tastes have been augmented by an impressive array of species from far-flung fisheries (e.g. substitution of walleye pollock for cod (Kurlansky 1997)). While a boon to adventurous gourmets, this increasing diversity of fisheries products has, in many cases, disguised stock declines in once-common seafood species, thus cushioning consumers from the scarcity and price effects of over-fishing (Mackinson *et al.* 1997; Pauly *et al.* 1998). To keep pace with the demands for this wide variety of seafoods, suppliers scour the oceans for additional harvest capacity in present and potential fisheries, deploying capital, technology and political leverage (Garcia *et al.* 1999; Pauly *et al.* 2002). Meanwhile, in developing countries, local fisheries resources, previously used only as subsistence protein or ignored altogether, are now being fished to supply international markets, resulting in gains in foreign currency but losses to the local food base and ecosystem (Le Sann 1998; Platt McGinn 1998; Kaczynski and Fluharty 2002).

East Asia strongly influences this global seafood demand. The traditional importance of fisheries products in the diet and as health tonics, as well as the increasing buying power and standards of living as its economies develop, have resulted in some East Asian countries ranking amongst the world's highest in per capita seafood consumption (FAO 2002a).

**Figure 1** Annual per capita seafood consumption in selected eastern and western countries, 1981–2000 (FAO 2002a).



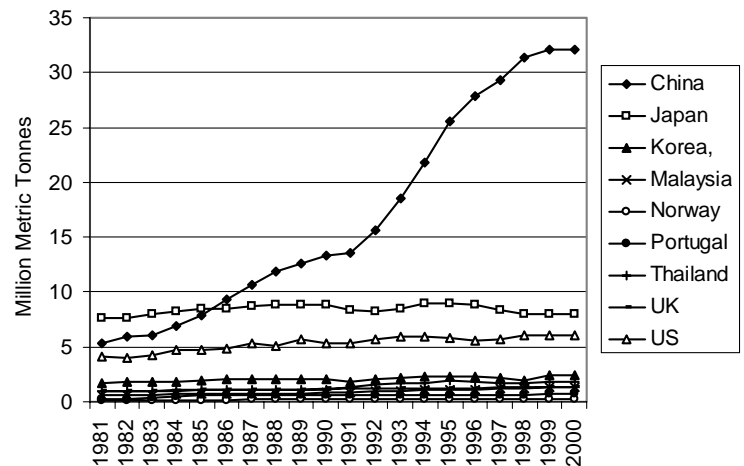
Examination of consumption rates in a selection of East Asian and western countries with known affinities for seafood (Fig. 1) reveals that while levels of consumption have remained steady in developed East Asian and western countries (e.g. Japan, Norway, the UK and the USA), a substantial increase in seafood consumption has occurred in East and South-east Asian countries (e.g. China, Malaysia and Thailand), undergoing rapid economic expansion in the 1990s.

When these trends are combined with population growth patterns (Fig. 2; FAO 2002a), particularly in the People's Republic of China (PRC), the extent of the current and potential future East Asian demand for seafood is striking. A recent analysis of the PRC's national fisheries statistics, as reported to the United Nations (UN) Food and Agriculture Organization (FAO), indicates that reported catch rates may be inflated by as much as double the actual amount in order to meet national production targets (Watson and Pauly 2001). While it is not clear whether seafood consumption figures may also be over-reported to

FAO, the scale of China's demand is such that even a 50% reduction in reported consumption would still exert tremendous market pressures.

In parallel with the high and/or increasing consumer demand in East Asian countries, local resources have suffered from over-fishing as well as from the effects of coastal development and associated pollution (Pitcher *et al.* 2000). Although China (including Taiwan) and Japan still rank within the top five seafood-producing countries of the world (FAO 2002a), the fisheries resources in waters surrounding these countries are under severe pressure; 58% of fish stocks of the Western Central Pacific (Gulf of Thailand and the Philippines to Fiji) and 70% of fish stocks in the North-west Pacific (northern South China Sea to Siberia) are considered to be exploited at or beyond their maximum sustainable yield (FAO 2000). As a result, East Asia's growing demand for fish protein is increasingly being met through a combination of culturing (captive rearing) and distant water fishing (Conover and Dong 1998a; FAO 2000).

**Figure 2** Annual total seafood consumption (per capita consumption multiplied by population) in selected eastern and western countries, 1981–2000 (FAO 2002a).



East Asian tastes in seafood vary widely, but can be broadly split into a North-east Asian market, based in Tokyo and supplied by Japanese, Taiwanese and Korean fleets, and a South-east Asian market with key entrepôts in Hong Kong and Singapore. The key products in these two markets are easily distinguished. While the upper end of the North-east Asian market focuses on tuna, usually transported in fresh or frozen form, and served raw, the South-east Asian markets, particularly Chinese consumers, find this fish too oily and coarse for their taste. Instead, Chinese and South-east Asian haute cuisine values large reef fishes, such as groupers, which are usually transported in live form and steamed to maintain the delicate flavour (Lee and Sadovy 1998). As both tuna and reef fish stocks near the major markets are insufficient to meet demand, supplies are now dependent on capital-intensive, distant fishing operations and dedicated product handling chains to maintain quality during extended transport (Safina 1993; Lau and Parry-Jones 1999).

In contrast to these high-profile seafood products, dried seafood products are usually cheaply sourced and transported, and require little special care. The popularity of these products, particularly in the Chinese and South-east Asian markets, dates back to the time when consumers could not afford expensive seafoods. In addition, refrigeration was not commonly available and sun-drying of seafood provided a low-cost means of preserving quality during shipment and prior to use (Conover and Dong 1998a). Today, dried seafood is considered a traditional or even old-fashioned taste, and it appears that in more urban and cosmopolitan environments, fresh, frozen or ready-prepared seafoods are gaining in popularity. Regional databases confirm that the percentage of marine fish catches processed into dried forms has dropped in recent years from 20 to 5% (SEAFDEC 1999, unpublished data, *SEAFDEC Online Fishery Statistics for 1991–95*, accessed online in September 2001 at <http://www.seafdec.org>; 2000, 2001).

Chinese and South-east Asian cuisine utilizes dried fish in whole form and as fillets, fish maws (swim bladders), skin and bones; dried mollusks such as abalones, scallops, and oysters; dried crustaceans including several species of shrimp; and dried echinoderms (bêche-de-mer, sea cucumber or trepang). Some dried marine organisms are consumed in the belief that they will convey a health benefit (either as a medicine or as a tonic) or because consumption is traditionally auspicious (Yeung *et al.* 2000). Although traders and consumers sometimes cite health bene-

fits associated with the consumption of shark fins and the use of shark products within traditional Chinese medicine (TCM) has a lengthy, and well-documented history (Rose 1996), shark fins are more commonly served in restaurants than dispensed by TCM practitioners. This is also true for bêche-de-mer and fish maws. The four products selected for analysis in this study, i.e. shark fin, abalone, bêche-de-mer and dried fish and fish maws, were chosen as representative of the dried seafood trade in Hong Kong, the largest entrepôt in Asia and a major supplier to Mainland China.

## Product history and background

### Shark fin

Shark fin, known as *yu chi* in China (魚翅, English equivalent 'fish wing'), has been considered a delicacy in Chinese cuisine since the Sung dynasty (960–1279 AD), and the dish was established as a traditional component of formal banquets by the Ming dynasty (1368–1644 AD; Anonymous 1995; Rose 1996). Fins are prepared by removing the golden-coloured collagen fibres lying between the cartilage and boiling them in chicken stock to produce the distinctive flavour of the dish (Anonymous 1995).

Shark fins have long been sourced through foreign trade and are recorded as one of the components of the traditional economy of Borneo, where Chinese merchants have been trading for many centuries (Payne *et al.* 2000). Hong Kong, which serves as an entrepôt for Mainland China, has been the centre of the world trade in shark fins for many decades, with a large portion of the remaining trade transiting Singapore (Kreuzer and Ahmed 1978; Parry-Jones 1996; Vannuccini 1999). Estimates of Hong Kong's share of world imports have varied between 50 (Tanaka 1994, based on data through 1990) and 85% (Vannuccini 1999, based on 1992 data), and Hong Kong is known to import shark fins from 125 countries or areas (Parry-Jones 1996).

The low demand for shark meat and the fluctuating markets for other shark products (i.e. skin, liver oil, cartilage and teeth), with changes in fashion, medical knowledge and the availability of substitutes (Rose 1996), make it likely that the demand for fins is increasingly driving shark mortality. Shark fins, particularly those from highly desirable species, are some of the most expensive seafood products in the world, and commonly retail for over US\$400 kg<sup>-1</sup> in Hong Kong (Parry-Jones 1996; Fong 1999). No

definitive study of the species composition of the entire trade has been conducted, although knowledgeable traders in Hong Kong indicate that approximately 30–40 species' fins are usable (Yeung *et al.* 2000). Documentation of the proliferation of finning (i.e. removing the fins and discarding the remainder of the carcass at sea) in some fisheries and the associated wastage (e.g. Camhi 1999) has recently led to a national ban on shark finning in the US waters (Federal Register 2002). Other countries which prohibit or control shark finning include Australia, Brazil, Costa Rica, the European Union, Oman and South Africa (Fowler *et al.* 2003).

Regardless of finning prohibitions, there are very few jurisdictions world wide which limit the number of sharks caught. Although three species of shark were proposed for listing on Appendix II at the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Conference of Parties in 2000, none was accepted. Subsequently, the basking shark (*Cetorhinus maximus*) was listed by the European Union and the great white shark (*Carcharodon carcharias*) was listed by Australia, on CITES Appendix III, which requires export/import licenses between the listing state and any other country party to CITES for trade in that species. At the CITES Conference of Parties in 2002, both the basking shark and the whale shark (*Rhincodon typus*) were listed on Appendix II, which requires export permits certifying that the trade is not detrimental to the survival of the species as well as data collection and reporting by all countries involved in the trade (CITES 2002). The 2002 IUCN Red List includes one species of elasmobranch in its Critically Endangered category, four species in its Endangered category and 13 species in its Vulnerable category (IUCN 2002, unpublished data, *IUCN 2002 Red List of Threatened Species*, accessed online in November 2002 at <http://www.redlist.org>). Concerns regarding the lack of fisheries management mechanisms for sharks have recently been articulated in the FAO International Plan of Action (FAO 1999).

### Abalone

Natives of coastal China have undoubtedly consumed local species of abalone (鮑魚, *bao yu*) for millennia, but according to Hong Kong traders, the first historical account of this seafood dates from the Han dynasty (206 BC–220 AD). While pursuing a coastal campaign against General Xiang Yu, Emperor Liu Bang noticed fishermen eating an unfamiliar

greenish mollusk. Emperor Liu Bang developed a taste for the dish and incorporated it into official Han dynasty cuisine, as a result of which its fame and popularity spread. Abalone is still widely enjoyed in Chinese cuisine, particularly at banquets and special occasions. Recipes utilizing dried abalone require 1–2 days of product presoaking, followed by at least 12 hours of simmering, which may explain the popularity of other forms, such as canned abalone, which require less preparation.

International trade in abalone dates as far back as at least the 1880s in Tasmania, where Chinese merchants were reported to be harvesting, drying and exporting abalone to China (Prince and Shepherd 1992). South Africa began canning abalone for the East Asian market as early as 1953 (Tarr 1992), and Oman's most expensive seafood product, the Omani abalone, has been dried and exported for the Chinese market since at least the 1970s (Johnson *et al.* 1992). As of the early 1990s, Japan and China were said to consume over 80% of the world catch of abalone, with Japan demanding the premium products in live, fresh and frozen form, and China, with Hong Kong as its entrepôt, importing the bulk of canned and dried production (Oakes and Ponte 1996). Commercial abalone products are derived from at least 25 species (and subspecies) of the genus *Haliotis* (Huang 1998). For the Chinese market, products are identified by brand name rather than by species, and particular brands, which may include a mix of species, are distinguished by product size, texture and meat colour (Oakes and Ponte 1996).

Conditions for abalone production are most favourable in temperate and subtropical waters of Australia, Canada, China/Taiwan, Japan, Mexico, New Zealand, South Africa and the USA. In most of these countries, however, over-exploitation of natural resources has occurred, and strict management measures have been implemented to sustain the remaining limited harvests (Prince and Shepherd 1992; Tarr 1992; Oakes and Ponte 1996; Huang 1998). The resulting declines in supply are increasingly being met by cultured abalone products (Huang 1998) that generally command higher prices (Oakes and Ponte 1996). In the decade beginning in 1989, wild abalone fisheries were estimated to have declined by 32% (from 14 830 to 10 150 mt), whereas cultured abalone production increased by over 600% (from 1220 to 7775 mt), mainly based on operations in China and Taiwan (Gordon 2000). Difficulties in differentiating between legal wild-caught, poached and cultured products in trade statistics complicate assessment of the

relationship between trade quantities and population status. In addition, it is often not clear whether culturing operations are impacting remaining wild populations through collection of breeding stocks. USA recently listed the white abalone (*Haliotis sorenseni*) on the federal endangered species list, which provides protection for remaining habitats, forbids collection or handling, and prohibits interstate and foreign commerce without a permit (Federal Register 2001). Several other species world wide are proposed for similar listings and/or are protected by regulations, but no abalone species are listed on the IUCN Red List of threatened species.

### Bêche-de-mer

The origins of bêche-de-mer, the market name for the dried body wall of sea cucumbers in Chinese cuisine, are not well known. However, the history of their commercial harvest dates back to at least 1000 years, and they were reportedly exported to China by Papua New Guinea and New Caledonia as early as the 18th and 19th centuries, respectively (Conand and Byrne 1993). Bêche-de-mer are known in China as 海參 (*hai shen*, English equivalent 'sea ginseng'), and are served as a health tonic as well as a common celebratory dish at banquets (Jenkins and Mulliken 1999). There are several steps involved in preparing the bêche-de-mer for transport and storage, including repeated boiling and drying (Conand and Byrne 1993) and several days of soaking and washing to prepare the dried form for consumption (Jenkins and Mulliken 1999).

Hong Kong has long been recognized as the world's largest entrepôt for bêche-de-mer (Sant 1995), and although Singapore and Taiwan also participate in the trade, Hong Kong currently controls 80% of the global supply (Jaquemet and Conand 1999). Traditionally, the lower-value products were shipped to Hong Kong for trans-shipment to Mainland China (Conand and Byrne 1993), but there is some evidence that the price differentials are levelling as the high-end market in China expands (Jaquemet and Conand 1999). While there are approximately 1200 species of sea cucumbers, only 300 of these can be utilized as bêche-de-mer (Sant 1995). Because of this wide diversity, there are many different countries who are supplying the Hong Kong, Singapore and Taiwan markets with significant contributions from Indonesia (Conand and Byrne 1993), the Philippines (Schoppe 2000) and a number of South Pacific island nations (Sant 1995). Collection of bêche-de-mer is

accomplished by hand or using spears in shallow water, and via free diving or SCUBA in deeper waters (Sant 1995). Market classification of bêche-de-mer uses the terms spiked and nonspiked, probably corresponding to the families Holothuriidae and Stichopodidae, respectively (see Carpenter and Niem 1998), to distinguish products. Despite some observations that the most expensive species in the Hong Kong market is the spiked Japanese sea cucumber, *Stichopus japonicus*, there is no clear consensus on consumer preferences for spiked or nonspiked product forms (Jenkins and Mulliken 1999).

Factors such as the ease of collection, and the absence of a local history of utilization and accompanying traditional resource management practices have caused many bêche-de-mer fisheries to suffer from over-exploitation. Examples include declining production in Tuvalu (Conand 1996), Mexico (Perez-Plasencia 1996) and Kenya (Samyn 2000), local depletions and/or size reductions in the Philippines (Schoppe 2000) and the Solomon Islands (Sant 1995), repeated failures to meet exploitation quotas in Vanuatu (Jimmy 1996) and over-fishing with apparent recovery in Papua New Guinea (Lokani *et al.* 1996). As of 1998, the Australian Fisheries Management Authority classified sandfish (*Holothuria scabra*) as over-exploited, and placed restrictions on harvests in some fisheries (Australian Fisheries Management Authority 1999). Bêche-de-mer fisheries have evolved to be an important source of income for many otherwise resource-limited communities, and increasing attention is being focused on monitoring the bêche-de-mer trade and on sustainable management of sea cucumber resources. The 12th Conference of Parties (COP) to CITES held in 2002 resolved that a technical workshop and associated studies of the bêche-de-mer trade be conducted prior to the next COP (CITES 2002).

### Dried fish

The term 'dried fish' is used in this study to refer to dried products of teleost (bony) fishes other than Syngnathids (seahorses, pipefishes and pipehorses). Even by limiting the term in this way, there is a broad diversity of product forms (whole, skinless headed and gutted), fillets, maws (literally fish stomachs, but used in the trade to refer to fish swim bladders), skin, bones and wide range of species represented in the trade. A recent market reconnaissance study in Hong Kong (Conover and Dong 1998b) found that the only form of dried fish product, excluding

shark fin, abalone and bêche-de-mer, still commonly sold was fish maws. A similar study of the Mainland China market found that whole dried fish products were only favoured by the older generations of Chinese and those at lower income levels, who maintain their traditional diet (Conover and Dong 1998a). While data collection under the present study encompassed both whole dried fish and fish maws, the trade in Hong Kong concentrates primarily on maws (Conover and Dong 1998b; and this study) as does the remainder of this background discussion.

In Mainland China and Hong Kong, fish maws are most commonly referred to as 魚肚 (*yu du*, English equivalent 'fish stomach'). However, the terms 魚鱔 (*yu biao*, English equivalent 'fish air bladder') or 魚膠 (*yu jiao*, English equivalent 'fish glue') may also be used. In most modern dishes, the fish maw is simply gently boiled with other ingredients, often chicken, to prepare a soup or broth. As for many other traditional foodstuffs, fish maws are believed to have medicinal properties and are commonly recommended, particularly in winter, as a tonic for those recovering from, or attempting to ward off, an illness (Lin 1939).

Foreign trade in fish maws to, or through, Hong Kong has been thriving for many decades. In the 1930s, source countries were recorded as the East Indies (Indonesia), Indo-China (Vietnam and Cambodia), Siam (Thailand), India and America (Lin 1939). Even earlier records indicate that fishermen off Baja California were harpooning giant croaker or totoaba (*Totoaba macdonaldi*), harvesting the swim bladders for the China market, and discarding the carcasses, often as large as 100 kg, to rot in the sun (Kira 2000, unpublished data, *The History of the Giant Totuava of San Felipe*, accessed online in September 2000 at <http://www.bajadestinations.com/totuava/totuahist.htm>). The continuation of Hong Kong as a trading centre for fish maws is likely because of two factors: the inability of local stocks to keep pace with demand, therefore requiring trade; and the value of maws used as a tonic as well as a food, which provides an incentive and sufficient income for middleman traders. In contrast, the market for dried whole fish (mainly in Mainland China) is supplied largely by domestic and PRC-flagged far-sea fisheries (Conover and Dong 1998a), thus bypassing trade in Hong Kong.

Fish maws are produced from a variety of species, with species of croaker being the most common. In general, the larger the species and individual, the more valuable the fish maw will be. Maws from male fishes are more valuable than those from female fishes, and those harvested in winter are also pre-

ferred (Lin 1939). Early processing involves splitting open the maw, washing it and drying it in the sun. During final processing, maws will be rewashed and bleached, and the smaller maws will be fried for direct sale to restaurants. In food preparation, a general guide to required quantities is that 1 catty (0.605 kg) of maw is adequate for 30 servings of most dishes that require it. Wholesale prices for individual fish maws in 1997 ranged from US\$101 for a small maw to US\$127 for a large maw (Conover and Dong 1998b). It is not unusual for fish maws of the giant yellow croaker or Chinese bahaba (*Bahaba taipingensis*) to be worth several tens of thousands of US dollars (Sadovy and Cheung 2003).

Given the difficulty of determining the fish species used to produce fish maws and whole dried fish (in part because of a lack of taxon-specific documentation of international trade), it is not possible to provide a detailed discussion of the conservation status of all species used. However, at least two species have been granted some measure of protection, in part, because of trade pressure. These include the totoaba (*T. macdonaldi*), which was listed under CITES Appendix I in 1977, and the giant yellow croaker or Chinese bahaba (*B. taipingensis*), which has been listed as a 'State Protected Species' by the PRC since 1988.

### Trends in the Hong Kong trade

Imports, exports and re-exports (exports of goods produced externally) were examined for all four dried seafood products in Hong Kong customs statistics databases (Hong Kong SAR Government 2001). These databases contain monthly and annual tallies of quantity, value, country of origin (of the product), country of consignment (origin of the shipment) and mode of transport, according to the Harmonized Commodity Description and Coding System of the World Customs Organization. The information is based on shippers' self-declarations, which are subject to inspection by Customs and Excise Department officials, and audit by Census and Statistics Department staff, but are not necessarily free from error. These data were used to explore the trade through Hong Kong as a potential indicator of expansion or contraction in the regional Chinese dried seafood market. Reported imports to Hong Kong potentially identify major suppliers on a global scale, and reported re-exports from Hong Kong indicate whether consumption is domestic, based in the Mainland China hinterland or farther afield. For some products, ana-

lyses of customs data were supplemented by interviews and field investigations to determine which fish or invertebrate species are utilized within the trade. More details on the interview methodology and findings are presented in a following section.

### Shark fin

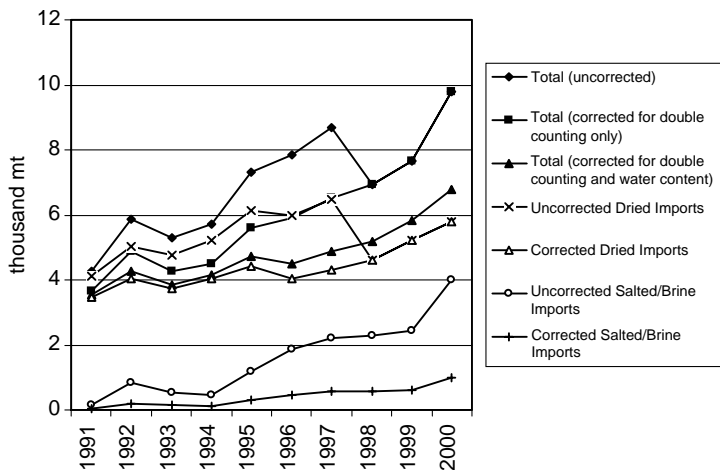
Analysis of unprocessed shark fin imports to Hong Kong from 1991 to 2000 was conducted to determine the growth and rate of change in the market over the past decade. Preliminary data adjustments were required to correct two factors that served to falsely inflate the import records. The first factor is the double-counting of imported fins, first as a raw product (when imported from supplying countries) and again as a processed product (fins received in Hong Kong are re-exported to Mainland China for processing and then re-imported to Hong Kong for sale). For data prior to 1998, before which time the Hong Kong commodity codes did not discriminate between raw and processed fins, all shark fins imported from the Mainland were assumed to be processed and were thus subtracted from Hong Kong's total dried imports (*sensu* Parry-Jones 1996) to provide the corrected total of dried unprocessed imports (Fig. 3).

The second correction factor arises from an increasing proportion over time of shark fins in the category 'salted or in brine' (Fig. 3). These fins are believed to represent traders' stocks of frozen fins, which, by 2000, composed 41% of reported unprocessed imports. Anecdotal information from traders (Vannuccini 1999; and this study) suggests that frozen fins are four times heavier than their dried equivalents. Additional evidence is provided by a comparison of the ratio of the average declared value

of unprocessed dried fins with the average declared value of unprocessed 'salted or in brine' fins from 1998 onwards. The ratio ranges from 21 to 36% (Clarke 2003). Based on this information, a correction factor of 0.25 was applied. The large increase in frozen fins parallels the increased participation of European countries, namely Spain, in the trade through Hong Kong since the mid 1990s (Clarke and Mosqueira 2002). However, the supply of shark fin derives from almost every ocean basin world wide as documented by the large number of countries ( $n = 86$ ) from which Hong Kong imported fins in 2000.

After adjustment, a regression was fit to the corrected data series for shark fin imports since 1991, which showed an average year-on-year increase of 6.1% (exponential form,  $R^2 = 0.89$ ;  $P < 0.001$ ). As Hong Kong imports unprocessed shark fins to supply both Hong Kong and China markets, the quantity of processed fins imported by Hong Kong from the Mainland and other countries was examined for 1998–2000 (as allowed by the database) to elucidate Hong Kong's consumption patterns. These figures show that between 80 and 90% of processed fins originate in the Mainland, and the total quantity of processed fins imported by Hong Kong is stable at approximately 1360 mt year<sup>-1</sup>. Although the number of data points available is too few to support a definitive inference, this finding suggests that as the quantity of processed fins imported by Hong Kong appears to be stable, the growth in Hong Kong's unprocessed imports is because of expansion of the Mainland China market and not because of increased consumption in Hong Kong *per se*.

When asked to explain which types of sharks' fins can be used, traders were somewhat vague about the species' identification, claiming that many spe-



**Figure 3** Imports to Hong Kong of dried; salted or in brine; and total shark fins 1991–2000. All figures prior to 1998 have been adjusted for double-counting of re-imported processed fins per Parry-Jones (1996). Salted or in-brine imports have been additionally adjusted for water content (see text), and the adjusted values and the resulting adjusted total are presented as separate data series.



cies can be used (all the seven traders interviewed, and others consulted informally (Clarke 2003)). Four traders cited 'whale' shark fins as valuable, three mentioned 'basking' sharks and others mentioned 'tiger' sharks, 'brown' sharks and 'hammerheads'. All respondents identified that the caudal fins were the most valuable as they contain the densest and thickest fin rays for soup. However, in general, traders state that long and thick fin rays command the best prices; thus fins which have a high density of these types of fin rays, regardless of fin position, are most preferred (Fong and Anderson 2000). While 'whale' shark and 'basking' shark fins have long and thick fin rays, they

are not particularly dense and otherwise lack texture; thus these fins while highly valued on a per-fin basis, are not particularly valuable by unit weight. Studies matching Chinese trade names used in Hong Kong with species or genera via genetic techniques, and determining the species composition of the trade through statistical modelling are reported in Shivji *et al.* (2002), Clarke (2003) and Clarke *et al.* (2003).

### Abalone

Assessment of the abalone trade through Hong Kong is complicated by the use of four separate commodity

**Table 1** Imports and re-exports of abalone products to Hong Kong, 1991–2000

Year	Reported quantities in Hong Kong trade database (mt)				Quantities adjusted to live-in shell weight equivalents (for non-live forms)			Total (in live-in shell weight equivalents)
	Dried, salted, or in brine	Frozen	Prepared or preserved	Live, fresh or chilled	Dried, salted or in brine	Frozen	Prepared or preserved	
<b>Imports</b>								
1991	113	446	1338	301	1130	297	3680	5408
1992	184	527	1563	342	1840	351	4298	6832
1993	173	460	1092	471	1730	307	3003	5511
1994	178	610	1280	302	1780	407	3520	6009
1995	169	552	973	460	1690	368	2676	5194
1996	142	562	1072	260	1420	375	2948	5003
1997	181	617	1205	346	1810	411	3314	5881
1998	173	829	1139	832	1730	553	3132	6247
1999	143	686	1344	790	1430	457	3696	6373
2000	246	865	1154	707	2460	577	3174	6917
<b>Total</b>	<b>1702</b>	<b>6154</b>	<b>12160</b>	<b>4811</b>	<b>17020</b>	<b>4103</b>	<b>33440</b>	<b>59374</b>
<b>Re-exports</b>								
1991	36	27	553	2	360	18	1521	1901
1992	111	34	462	81	1110	23	1271	2484
1993	48	73	215	94	480	49	591	1214
1994	58	108	307	59	580	72	844	1555
1995	46	86	350	9	460	57	963	1489
1996	49	58	242	6	490	39	666	1200
1997	51	25	174	5	510	17	479	1010
1998	52	11	98	3	520	7	270	800
1999	42	94	136	2	420	63	374	859
2000	60	73	97	236	600	49	267	1151
<b>Total</b>	<b>553</b>	<b>589</b>	<b>2634</b>	<b>497</b>	<b>5530</b>	<b>393</b>	<b>7244</b>	<b>13663</b>

Live, fresh or chilled forms are assumed to be equivalent to live in-shell weights. Dried, salted or in brine; frozen; and prepared or preserved (assumed to be canned) forms have been converted to standardized live-in shell weights using the following conversion factors: live weight = dried weight  $\times$  10 (Gordon 2000); live weight = frozen weight/1.5 (derived for this study from wholesale price data); live weight = 5.5  $\times$  prepared abalone weight (Gordon 2000) and prepared abalone weight = canned weight/2 (derived for this study from gross versus net weights).

codes and the lack of well-documented conversion factors to standardize weights between different product forms. Hong Kong records abalone products as: dried, salted or in brine; frozen; live, fresh or chilled; and prepared or preserved. As illustrated in Table 1, some product forms, including live and frozen forms, show increasing import quantities, particularly in recent years. When all forms were standardized to live in-shell equivalents, imports increased from 5003 mt in 1996 to 6917 mt in 2000, but did not greatly surpass levels observed in the early 1990s (Table 1). Re-exports have fallen contributing to a concomitant rise in domestic consumption (i.e. the difference between imports and re-exports), of approximately 4.6% per annum (exponential form,  $R^2 = 0.63$ ;  $P < 0.005$ ). Illegal and otherwise unrecorded re-export of abalone to avoid customs duties may misleadingly inflate the Hong Kong domestic consumption figures, but this cannot be quantified with available data.

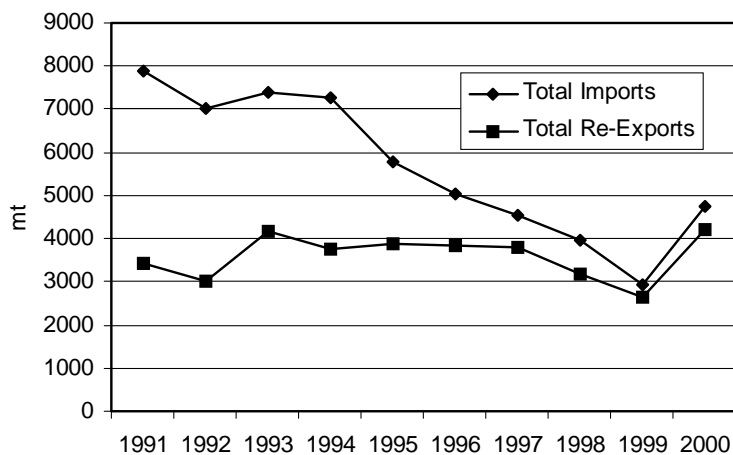
Hong Kong abalone dealers indicated that a type of dried abalone called 'Kat Pun Bao', as well as one referred to as 'Wo Ma', from Japan, were the most sought-after products. Some (four of the five traders interviewed) mentioned South Africa, the Middle East and/or Australia as high-quality suppliers, but others ( $n = 2$ ) considered that South African and Australian production was inferior to that of the other countries mentioned. Low-grade products, which are difficult to soften for cooking, were said to be sourced from Indonesia and the Philippines ( $n = 5$ ). Traders claimed that supplying countries had not changed over time ( $n = 5$ ). No species identification investigation was undertaken for this product.

### Bêche-de-mer

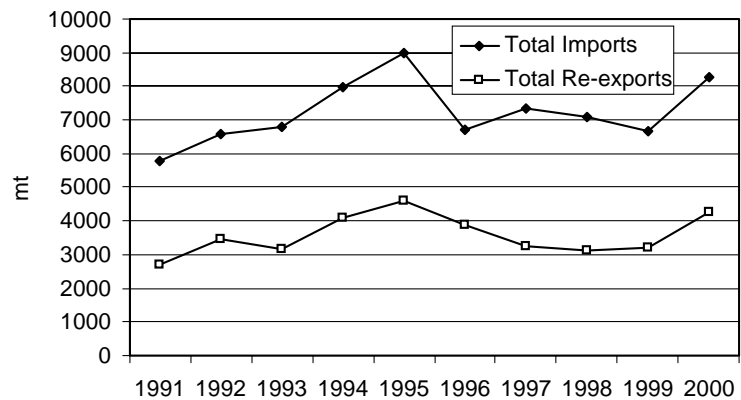
Bêche-de-mer is traded in a variety of forms including dried, salted or in brine; frozen; or prepared and preserved. However, Hong Kong customs data employ only one code specific to bêche-de-mer (dried, salted or in brine), and thus, only this category was examined as the potential indicator. A comparison between Hong Kong's imports and re-exports of this product (Fig. 4) illustrates that Hong Kong domestic consumption has fallen by 30% year-on-year (exponential form,  $R^2 = 0.90$ ;  $P < 0.001$ ) in the last decade such that domestic consumption, which accounted for 56.5% of imports in 1991, now only accounts for 4.5% (average based on 1998–2000 data).

In the last 5 years of the time series, 87% of Hong Kong's bêche-de-mer re-exports were destined for the Mainland; therefore, despite the apparent decline in domestic consumption, Hong Kong's role as an entrepôt for dried sea cucumber remained intact. During the period 1996–2000, Hong Kong reported receiving more than 500 mt of bêche-de-mer from Indonesia, the Philippines, Papua New Guinea, Singapore, Fiji, Madagascar, the Solomon Islands and Tanzania. These countries, with the exception of Singapore, are producers rather than traders, and reflect the major global bêche-de-mer-producing countries (FAO 2002b). The upturn in Hong Kong imports in 2000 was led by large increases in products from Indonesia and the Philippines.

Traders in Hong Kong indicated that spiked forms of bêche-de-mer, particularly *Thelenota ananas*, *S. japonicus* and *Stichopus* spp., were the most valuable species (all the five traders interviewed). This is in contrast to Jenkins and Mulliken (1999), who stated



**Figure 4** Imports and re-exports of dried, salted or in-brine bêche-de-mer reported in Hong Kong, 1991–2000, showing a decline in domestic consumption, i.e. the difference between imports and re-exports.



**Figure 5** Imports and re-exports of dried fish reported in Hong Kong, 1991–2000.

that while spiced forms command high prices in Hong Kong, they do not appear to be popular with consumers, perhaps because of high prices. One trader also mentioned White Teatfish (probably *Holothuria fuscogilva*, a nonspiked form) as a valuable species, and two others listed it as a commonly carried product. Most traders ( $n = 4$ ) indicated that the larger-sized species and species from Japan (probably spiked forms) are preferred.

#### Dried fish

Hong Kong's imports and re-exports of dried fish over the past decade, which are expected to include whole dried fish, fillets, maws and possibly other products, do not show any significant trends, and therefore show steady rates of domestic consumption (Fig. 5). Between 1996 and 2000, Hong Kong reported importing more than 2000 mt of dried fish each from Mainland China, Bangladesh, Vietnam, India, Indonesia, Thailand and Kenya. Similar to shark fins, the number of countries from which exports are received by Hong Kong is large (73), and represents a broad geographical range. However, as the commodity code used by Hong Kong does not distinguish between types of dried fish, it is difficult to relate Hong Kong's major suppliers to existing production data, e.g. the FAO data set.

Despite being the largest supplier of dried fish to Hong Kong, Mainland China is also the country receiving the greatest quantity of reported re-exports of dried fish from Hong Kong. The explanation for this dichotomy may lie in the trade flows of different products classified under the dried fish commodity code. For example, it is likely that Mainland China is supplying local, small whole fish to Hong Kong and importing from Hong Kong large, valuable fish maws that cannot be sourced locally. Without further differentiation of products within the commodity code, it is

not possible to verify which products are following which routes.

Dried fish traders (all of the six traders interviewed) did not demonstrate a detailed knowledge of the species utilized by the trade. Therefore, a species identification exercise was conducted for this study at several dried fish shops in Hong Kong (Table 2). Fish maws were also examined, but could not be taxonomically identified (Table 3). Interviews with two fish maw traders confirmed general valuation guidelines including that marine fishes' maws are preferred to those of freshwater fishes (one confirmed, one did not know), male fishes' maws are more highly valued than females' maws ( $n = 2$ ) and the most expensive maws are derived from 'croakers', probably Sciaenidae ( $n = 2$ ).

#### Utility of Hong Kong data in global monitoring

Having identified market trends in Hong Kong and, in some cases, its hinterland Mainland China, trends were then examined to determine whether they were indicative of world wide patterns in dried seafood production and trade. Hong Kong dried seafood statistics were first compared to other national customs databases to assess whether statistics from Hong Kong more accurately documented trade flows. Subsequently, national figures from Hong Kong and other trading partners were compared to FAO global databases, and discrepancies were identified and interpreted. Where warranted, alternative estimates of global trade quantities were constructed.

#### Meta analysis of regional dried seafood customs data

Past trade studies (Parry-Jones 1996) have suggested that Hong Kong, as a duty-free port, should have an

**Table 2** Concordance between Hong Kong market names and scientific taxa for dried fish products in whole form

Chinese name	Common name	Scientific name	Retail (R) or wholesale (W) price (USD kg <sup>-1</sup> )	Source location (as cited by traders)
公魚	Anchovy	Engraulidae	2–9 (R)	China
丁香魚	Anchovy	Engraulidae	9 (R)	NA
竹簽 and possibly 鮫魚	Barracuda	Sphyraenidae	~4–6 (R)	NA
木棉	Big eye	<i>Priacanthus tayenus</i>	7 (R)	Local
黑	Black pomfret	<i>Parastromateus niger</i>	4–6 (R)	Local
白花鱸	Croaker	Sciaenidae	13–17 (W) 34 (R)	NA
牙或	Croaker	<i>Otolithes</i> spp. <i>Laramichthys crocea</i>	9–17 (W)	Bangladesh
沙	File fish	<i>Monacanthus</i> spp.	2–4 (R)	South China Sea
撻沙	Flat fish	Several species	2 (R)	Local
地魚	Flounder	NA	15 (R)	NA
黃魚	Gizzard shad	Clupeidae	2–4 (W)	Local
紅衫	Golden thread	<i>Nemipterus</i> spp.	4–6 (W) 9 (R)	Local
青鱗	Green pilchard	NA	4 (R)	NA
牙帶	Hair tail	Trichiuridae	4–6 (R)	Local
九棍	Lizard fish	Synodontidae	5 (R)	Local
鮫魚	Mackerel	NA	4–6 (W)	Thailand
花鮫	Mackerel	Scombridae	> 2–4 (R)	NA
銀魚	NA	Salangidae	17–34 (R)	China
油力	Pony fish	<i>Leiognathus</i> sp.	6 (R)	Local
泥	Rabbit fish	Siganidae	6 (R)	Local
紅魚	Red snapper	<i>Lutjanus</i> sp.	4–6 (R)	Singapore
池魚仔	Scad	Carangidae	2–4 (R)	
紅雞	Snapper	NA	4–6(R)	Bangladesh and many other places
黃祥	Talang	NA	2–4 (W)	Vietnam
馬友	Thread fin	Polynemidae	2–21 (W)	Vietnam
曹白	White herring	<i>Ilisha</i> spp.	6–21 (W) 11–64 (R)	Bangladesh and many other places
白	White pomfret	<i>Stromateidae</i>	2–4 (W)	Local

Common names are provided based on translation of Chinese names and/or traders' use of English names. Scientific names are only provided if verified by the field investigator.

advantage over other locations in compiling trade statistics as there would be little incentive to minimize declared quantities to reduce tariffs. The following analysis is thus based on the premise that if two countries' records for the same shipment are compared, the higher declared quantity will more accurately reflect the true traded quantity. The null hypothesis was that Hong Kong customs figures are equal to or less than customs figures of other jurisdictions for the same shipments. This was investigated quantitatively by examining whether the correlation coefficient between other countries and Hong Kong is less than 1 (assuming Hong Kong data on the *x*-axis).

This hypothesis was tested for dried seafood products by comparing import and export statistics between Hong Kong and trading partners Mainland China, Taiwan, Singapore and Japan (Anonymous 1997a,b,c,d, 1998a,b,c,d, 1999a,b,c,d, 2000a,b,c,d, 2001a,b,c,d). For each of the years 1996–2000, Hong Kong import records of each product from each country were compared to the export/re-export records from each consignment country. Similarly, Hong Kong's total export/re-export records in each year for each product were contrasted with the import figures from each receiving country. Several potential comparisons were omitted from the analysis because of major mismatches in commodity cat-

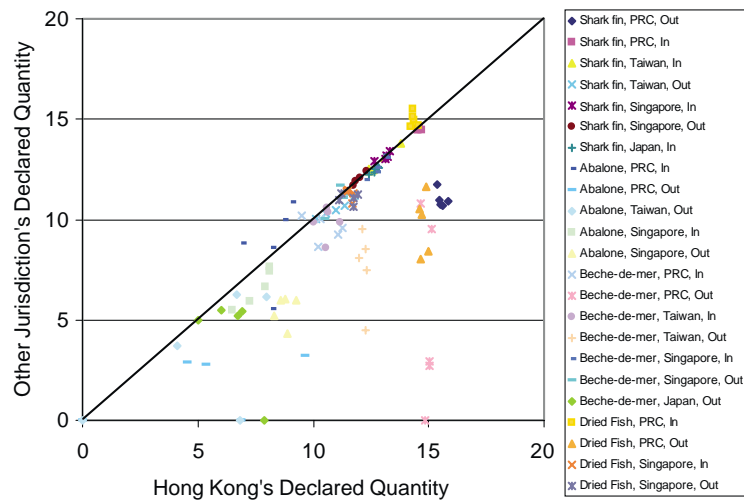
**Table 3** Concordance between Hong Kong market names and scientific taxa for dried fish maw products. Common names are provided based on translation of Chinese names and/or traders' use of English names

Chinese name	Common name	Retail (R) or wholesale (W) price (USD kg <sup>-1</sup> )	Source location
蜘蛛肚	Spider maw	>213–638 (R/W)	NA
肚	Man To (Croaker's maw)	>170 (W)	Venezuela
安南肚	(On Nam) Man To	153 (W)	Vietnam
白花膠	Pak Fa Kau (white croaker's air bladder)	319 (W)	India, Vietnam and Bangladesh
扎膠	Chat Kau	85–106 (W) 106–170 (R)	Brazil and Ecuador
鴨泡肚	Ap Bau To	43 (W) >43–85 (R)	Amazon River, South America
鱔肚	Eel maw, Sin To/Sin Kau	36 (W)	Bangladesh
赤魚膠	Chek Yue Kau	36 (R)	Hong Kong, Philippines, and elsewhere, air bladder from catfish
炸鱔肚	Fried eel maw	>21 (W)	NA

egories or no recorded trade between partners in a given direction in any of the five years examined. In total, 115 data pairs were compiled and plotted (Fig. 6).

The correlation coefficient ( $\rho$ ) was 0.68, and the null hypothesis that  $\rho = 1$  was rejected ( $P < 0.001$ ; Zar 1999), thus confirming that Hong Kong figures are generally higher than those of other countries. There are only two data sets which lie primarily

above the reference line. These are the Hong Kong imports (i.e. 'In') from the Mainland for dried fish and abalone. Discrepancies in these trades' customs data may be explained by the range of products classified under the commodity code for dried fish (see above), and potential confusion between dried and canned abalone (i.e. 'in brine' versus 'preserved (canned)' coding ambiguities). A far greater number of points lie



**Figure 6** Meta analysis of dried seafood import and export figures for four products traded between Hong Kong and Mainland China, Taiwan, Singapore and Japan, 1996–2000. Each data point represents a location on a  $(x, y)$  coordinate plane where  $x$  is the value recorded in Hong Kong and  $y$  is the value recorded in the other country. All data are log (ln)-transformed. In the legend, each point is described by product type, the trading partner the shipment is heading to (or arriving from) and the direction of the shipment standardized to Hong Kong (e.g. 'Shark fin, PRC, Out' is a shipment of shark fins exported from Hong Kong and imported by Mainland China).

**Table 4** FAO production and trade statistics for Hong Kong, Mainland China and global imports, 1996–2000 (FAO 2002b), and Hong Kong total (processed and unprocessed) imports (Hong Kong SAR Government 2001)

	1996	1997	1998	1999	2000
Hong Kong Imports according to FAO	1850	2211	13	14	23
Mainland China Imports according to FAO	4363	4389	4236	4062	4646
FAO Production and Trade Database Total Imports	7010	7046	4630	4584	5242
Hong Kong Imports according to the Hong Kong Government database	7846	8670	8323	9935	11451

below the reference line, indicating that Hong Kong's reported quantity was higher. Particularly egregious discrepancies are noted for Mainland China import–Hong Kong export trade in shark fin, dried fish and bêche-de-mer (i.e. 'Out'). The fact that PRC export data for these same products are highly consistent with or above the Hong Kong import figures (i.e. 'In', trade in the opposite direction) suggests that the major discrepancy in Hong Kong exports–Mainland imports may be because of a practice on the Mainland of not recording incoming goods destined for processing as imports because they are nondutiable. If so, Mainland imports of unprocessed products are severely under-represented in official statistics. Other extreme, but isolated, points occur when Hong Kong's declared quantities are paired with zero or near-zero values from the other jurisdiction. This occurs for abalone traded to Taiwan and to the Mainland, and bêche-de-mer to the Mainland and to Japan.

While these results encourage the use of Hong Kong trade data over other sources of customs data, they do not address the degree to which the Hong Kong statistics are an accurate reflection of the trade. It is unlikely that Hong Kong customs declarations would be falsely inflated except by mistake, and in interviews, Hong Kong traders acknowledged that they under-report on declaration forms. Thus, while it is safely assumed that even in Hong Kong reported quantities are underestimates of actual traded quantities, there is currently no quantitative basis for upwardly adjusting the Hong Kong figures.

With regard to adjusting for underestimation in other countries, this analysis has shown that four other jurisdictions with voluminous trade in dried seafood report declared quantities which are biased towards under-reporting (under the assumption that higher quantities are more accurate). As it is possible that discrepancies in the other commodities may be because of improper product form differentiation, average percentage discrepancies between Hong Kong figures and the other jurisdictions were calcu-

lated only for shark fin and bêche-de-mer, where this issue was less pronounced. For this subset, the difference between each pair of points, i.e. Hong Kong minus other, was divided by the Hong Kong figure, and then averaged over all trade directions and years for each product. For shark fin, the declared quantities from the other jurisdictions were, on average, 24% lower than the Hong Kong statistics. For bêche-de-mer, the average bias towards under-reporting was even greater (49%).

While this analysis is based on only a limited number of data points, it suggests that Hong Kong trade statistics provide a more accurate representation of trade flows in dried seafood products than other Asian countries. Aside from differences in commodity coding, under-reporting in other national databases may be encouraged by tariff schedules, and has been inferred to range from 24 to 49%. Correction for relative differences would bring other national statistics in line with Hong Kong figures, but will not, however, address under-representation arising from under-reporting in the Hong Kong data.

#### Comparison to existing global trade estimates

The FAO production and trade database was examined for shark fin over the 1996–2000 time-frame (FAO 2002b). Comparisons between this database and Hong Kong trade figures for abalone, bêche-de-mer and dried fish were hampered by inconsistencies between commodity codes, and are not presented here (Clarke 2002).

According to FAO, global import totals for shark fin between 1996 and 2000 decreased from a high of 7046 mt in 1997 to 4584 mt in 1999, and subsequently increased to 5242 mt in 2000 (Table 4).<sup>1</sup>

<sup>1</sup>While this manuscript was in review, FAO was notified of the issues raised here and subsequently revised their figures in the 2003 release of the FISHSTAT databases.

These global figures, which presumably include both unprocessed and processed shark fin, would, by definition, be expected to equal or exceed the total shark fin import figures of Hong Kong. However, a comparison reveals that the uncorrected Hong Kong total (processed and unprocessed) shark fin import statistics exceed the FAO global import figures by large amounts (1.1–2.2 times greater; Table 4). When FAO statistics are examined further, it is apparent that the total is highly dependent on the contribution of Mainland China. For each year, Mainland China contributes the largest quantity to global imports, ranging from 62 to 91% of the total. While the reported figures for Mainland China correspond exactly to those reported in the PRC national customs database for the same period, the results of the meta analysis above have demonstrated that imported quantities are likely to be gross underestimates. Given this, and observing that the FAO-reported Hong Kong quantities are much lower than figures in Hong Kong's own database, the FAO data set underestimates world trade in shark fins through deflated figures for the world's two largest participants at a minimum. In addition, unlike the Hong Kong data, the FAO statistics fluctuate from year to year, but do not indicate any growth in the shark fin trade. Use of the FAO figures to characterize trends in shark fin trade may thus also lead to false conclusions.

An alternative estimate of total world trade in shark fins was compiled using national customs databases, and is presented in Table 5 for comparison. The estimates of the total quantity of shark fins

traded per annum from 1996 to 2000 range from 8485 to 10 138 mt. These estimates are believed to be underestimates because of several assumptions in the analysis. First, only trade in the largest shark fin markets was included and the total actual global trade would undoubtedly be higher. Second, for customs systems which do not distinguish between processed and unprocessed fins, such as Mainland China, Singapore and Japan, this analysis assumed that the declared weights were unprocessed fins. If, however, the declared weights were actually processed fins, the equivalent unprocessed weight could be on the order of three or more times higher (Parry-Jones 1996). Third, shark fins passing through customs systems are often under-reported to minimize tariffs, and many shipments are thought to bypass the official record-keeping system by using unofficial or illegal trade routes (TRAFFIC 1996; Clarke 2002). Finally, shark fins produced and consumed within a single country (i.e. domestic consumption) are not recorded in trade statistics and are therefore excluded from this estimate.

Biases leading to overestimation may also be present in the database, but these influences are expected to be minimal compared to those underestimation biases discussed above. The main concern in this regard is the assumption for Mainland China, Singapore and Japan databases that unspecified fins were dried rather than frozen ones. If substantial quantities were indeed frozen, the actual quantity of shark fins in those shipments would be overestimated by a factor of four.

**Table 5** Alternative estimate of imports of unprocessed shark fins (mt) based on the major Asian trading nations. Data from Hong Kong, Mainland China and Singapore, which were assumed to represent the major shark fin entrepôts, are presented as declared imports (Hong Kong figures adjusted as explained in text) minus imports from the other two entrepôts to avoid double counting

Country	1996	1997	1998	1999	2000
Hong Kong	4061	4414	4086	4489	5501
Mainland China	3889	3941	3893	3645	3960
Singapore	786	606	444	596	520
Taiwan	5	31	62	69	156
Japan	10	23	0.3	1	1
Total of the above National Estimates	8751	9015	8485	8800	10138
Adjusted Hong Kong Imports (Fig. 3)	4513	4868	5196	5824	6788
Hong Kong Percentage of Total	52%	54%	61%	66%	67%

For Taiwan and Japan, which are major shark-fishing nations as well as shark fin consumer markets, imports were tallied in the same manner as for the entrepôts (i.e. subtracting the other countries' shares), but exports were also included to account for excess domestic production entering the trade. Taiwan's reported frozen fins were adjusted for water content. All unspecified fins were assumed to be unprocessed and dried.

The estimate of Hong Kong's share of the world market ranges from 52 to 67%, with a mean value of 60% for all years combined (Table 5). This estimate is undoubtedly also affected, to an unknown extent, by the potential over- and underestimation biases discussed above. In particular, excluding domestic production and consumption from the estimate may serve to underplay the role of countries like Taiwan and Japan in the shark fin trade and over-emphasize the importance of Hong Kong. Furthermore, if the contributions from the other countries shown in Table 5 are inflated to account for the identified 24% under-reporting described in the previous section, Hong Kong's mean share would be reduced to 52% of global trade.

### **Hong Kong dried seafood trade structure and implications for fisheries management**

The market structure and business practices of the dried seafood trade in Hong Kong were investigated to determine at which points in the supply chain, and to what degree, dealers were aware of and sensitive to resource depletion or regulation. Findings are intended to provide a qualitative characterization of the trade community and gauge its responsiveness to various forms of potential management or conservation action.

During the period June–August 2001, a total of 69 dried seafood wholesalers and retailers (traders) were observed during reconnaissance surveys to determine the diversity of products traded. Of these businesses, 23 agreed to participate in individual structured interviews. The interviews, consisting of 27 questions, were conducted by a native Cantonese speaker with a graduate qualification in Biology, who introduced herself as conducting research on the business structure of the trade. The interviews followed a casual, conversational style, rather than adhering strictly to a predetermined order of questions. Each interview focused on one product, even if more than one product was carried by the responding wholesale or retail establishment. In total, seven shark fin, five abalone, five *bêche-de-mer*, two fish maw and four whole dried fish interviews were conducted. In summarizing the findings below, points relating to specific questions and responses are annotated with the number of respondents. Interview questions and responses are reported in full by Clarke (2002).

Based on the interview results, it was concluded that the most salient feature of the Hong Kong dried

seafood trade is its preoccupation with the sales side of the business and its limited knowledge of the resources from which the products derive. While many dealers were well-informed about product processing and resulting forms and grades, very few exhibited any knowledge of the biology of the organisms, the methods of capture or whether stocks (i.e. preharvest populations) were stable or declining. Also, as purveyors of luxury foodstuffs, it was surprising that the participants of the interview generally demonstrated little interest in the use of the products and did not articulate why certain products were desirable other than commenting on their sales performance.

The survey also explored the relative importance of supply versus demand to traders. Participants were given a list of potential constraints (i.e. 'lack of capital', 'scarcity of supply', 'poor quality of supply', 'lack of demand' or 'other') and asked to identify those which apply to their business. Of the 23 firms surveyed, 20 identified 'lack of demand' as the key constraint to their success. The second most commonly articulated factor ( $n = 5$ ) was Mainland China regulations and customs tariffs.

All firms were able to describe the factors they felt were contributing to the current low levels of consumer demand for dried seafood. A majority of firms ( $n = 21$ ) cited either the downturn in the regional economy and/or seasonal cycles, which follow the holiday calendar and traditional times for eating certain foods, as the most important factors. Only four firms suggested that prices or tariffs for those re-exporting to China had a large influence on demand, and only one dealer mentioned product supply or quality as the factor. This fixation on demand, at the expense of supply issues, assists in explaining why only a few of the interviewed firms ( $n = 2$ ) involve themselves in the financing or operation of overseas harvests. In the cases where this does occur, traders suggested that their motives were to prevent being outbid by competing traders for raw products, or to expand their operations and increase profits, rather than any perceived or anticipated decline in the buyer's market for raw product over time.

The structure and size of any given business was found to be determined by the proprietor's attitude towards business risk, the ability to establish and maintain trading relationships with overseas suppliers and the ability to advance capital for product purchase. The 69 businesses observed could not be easily partitioned by the combinations of products carried, with the exception of dried fish dealers



which focused almost exclusively on these goods (although some also sold small quantities of dried shrimps and cuttlefish). Of the 23 interviewed firms, seven specialized in one product (six of which were dried fish dealers), whereas 16 traded at least two of the dried seafood products examined in this study.

Only one firm suggested that their supplier dictates which products are to be sold. Goods are almost always purchased from overseas suppliers dealing in a single product, and thus, it is at the wholesale and retail level that products are combined into sets. Certain products, particularly shark fins, are seen as high-profit but high-risk commodities because of the need to advance large amounts of cash to suppliers and the considerable potential for fraud under such circumstances. While some firms choose to specialize in these potentially high-margin goods, others prefer to spread their risk by offering a range of goods, thereby providing a buffer against fluctuating prices and demand cycles.

The concentration of the dried seafood business in one district of Hong Kong (Lam 1990) may appear to be at odds with the observed highly competitive nature of the trade community. This physical proximity, however, provides a sense of security to traders in the way that they are able to visually track each other's shipments and customers while still guarding proprietary secrets such as prices and supplier names and addresses. Most dealers purchase goods with cash and often do not have the opportunity to inspect the goods before purchase. Therefore, relationships with distant suppliers are the foundation of their business, and once trust is established, dealers work to guard information about suppliers from competitors in Hong Kong. For these reasons, traders do not shift easily between suppliers and thus should, in theory, be aware of any changes in the availability of products.

The simple nature of dried seafood products does not encourage innovation within the trade. Aside from use of the latest communication technologies to allow instantaneous contact with overseas suppliers when necessary, traders rarely use computers for business management or the Internet for communication or advertising. The intensive focus on protecting supply contacts and key purchasing clients leads to a self-focused business outlook: very few traders ( $n = 6$ ) were able to estimate their share of the Hong Kong market or to contextualize the Hong Kong market within the world trade.

These characteristics also contribute to a largely passive attitude towards external factors influencing the trade. Most of the interviewed traders seemed

aware of, but unconcerned by, current or potential regulations or conservation campaigns. In response to a separate, specific query, only two respondents (both of them shark fin traders) indicated a knowledge of any current regulations applying to their trade, although five firms (all of them shark fin traders) acknowledged that future regulations could impact their businesses. When asked to comment on a hypothetical scenario of regulatory impacts on their business, almost all the respondents ( $n = 22$ ) indicated that they would do nothing, switch to a product that is not regulated or simply raise the price. Only one trader stated that he would participate in lobbying against potential regulations.

Trader attitudes demonstrated a prioritization of maintaining the business cash flow over any loyalty to the industry *per se*. Although nine of the 23 firms interviewed stated that the business was family-owned, and many of these had been operating for 30–70 years, none of the respondents replied affirmatively to a question asking whether they expected their children to carry on in the business. Several traders ( $n = 4$ ) stated that they actively discouraged their children from entering the trade as they believed the outlook for the future was not positive. While this finding appears to contradict the general trend of shark fin trade expansion in recent years, the short-term focus of most traders, in combination with the poor economic climate at the time of the survey, may have contributed to this gloomy outlook. Some traders also expressed distaste for the long hours and smell involved in the dried seafood business, and this may also have contributed to a lack of interest in continuing the business indefinitely.

The trade profile that emerges from these interviews is one of highly independent, conservative and self-focused merchants who are oriented towards short-term gains and are largely unconcerned with supply issues including resource sustainability and potential regulation. These findings suggest that traders would be most directly influenced by shifts in consumer demand rather than by limits on supply such as either harvest or trade restrictions, or calls for voluntary self-regulation.

## Conclusions

Short of obtaining standardized and meaningful data from each of the fisheries contributing to the market, analysis of trade data may be the most viable option for determining global harvest levels and sources for some products, or even in some cases, back-calculat-

ing extraction rates. If trade data are to be the basis of such assessments, customs data will continue to be the primary source of information. Import–export information from tariff-free entrepôts such as Hong Kong provides a constructive starting point as, for a limited number of products, this study has inferred that such data have smaller under-reporting biases than those from other trading centres. The utility of the Hong Kong customs data would be dramatically improved by establishing a Hong Kong-based customs inspection programme for products of marine conservation interest, even on a very small scale. Data from such a programme would provide quantification of biases in declared versus actual quantities and allow Hong Kong figures to be adjusted or bracketed within a confidence interval. The Hong Kong figures could then be used to adjust or bracket data from key trading partners using the pair-wise comparison technique for inbound and outbound shipments. These data would arguably provide the best regional and global estimates of traded quantities for species utilized primarily in Chinese markets.

In many cases in this study, traded quantities could not be compared because of discrepancies in commodity codes. Many systems exist world wide to harmonize such codes, yet even the subtlest of differences can prevent meaningful tracking. For the products considered in this study, two key recommendations are proposed for consideration by national customs administrations, regional bodies such as the Asia Pacific Economic Cooperation (APEC) forum or institutions with a global remit such as FAO, the World Customs Organization or CITES. First, establish codes which clearly distinguish between raw and processed shark fins and between frozen and dried raw fins (amend 'salted' designation to 'frozen', where necessary) and second, establish separate codes for fish maws in general as well as separate codes for perciform fishes' and eel-like fishes' maws. While many other amendments to commodity codes could be suggested, these two are deemed particularly critical to representative monitoring of dried seafood products derived from species of conservation concern.

Beyond improving customs data as the traditional platform for trade analyses, other means of monitoring trade and validating customs records should be pursued. An obvious benefit would arise from accessing trade records from the industry itself. Quantities and wholesale prices of most dried seafood products in Hong Kong are compiled by the traders' own organizations (Clarke 2002, 2003), and although these

data may prove difficult to obtain, they would provide a very important counterpoint to customs data. Another option would involve implementing a standardized monitoring programme of product harvest quantities in the source countries on a product-specific basis, perhaps through key dealership centres. Such a programme could only be accomplished where the supply centres are reasonably concentrated and freely accessible to monitoring personnel or other designated record-keepers. These recommendations would benefit both products which are not now monitored and those which are monitored primarily through customs data, such as those tracked by the World Conservation Monitoring Centre in support of CITES and other programmes (Green and Hendry 1999).

All of the above are means of obtaining improved data on trade. As such data will only provide a sample of the entire trade, a substantial improvement in estimating total traded quantities and associated harvest rates will require that these improved data sources be matched with improved methods for statistical modelling. Areas in particular need of improved techniques include conversion rates between raw and processed product forms; quantifying uncertainty in estimation of total traded quantities from customs statistics or other data sets where biases are suspected but poorly understood; and synthesising information from numerous sources and levels of certainty to form a basis for choosing between various action or management alternatives.

The urgency of undertaking any of the recommendations presented above depends on the level of conservation concern associated with the resources utilized in the dried seafood trade. This level of concern depends on the sustainability of current extraction practices for various stocks, and must be addressed on a case-specific basis. This study has instead focused on clarifying the likely volume of global trade and the role of Hong Kong in this trade.

Of the products considered in this study, the greatest amount of international conservation concern has been expressed about the status of shark resources (Fong and Anderson 2002; Baum *et al.* 2003). This study has shown that the global trade is likely to be considerably underestimated by the only available global database, and that the world trade is continuing to grow. Other findings concerning the proportional participation in the trade by e.g. European countries, may be useful for targeted shark fishery management regulations. The detailed exploration of customs statistics presented here, and

the findings concerning adjustments necessary to correct for overestimation and double-counting, can also guide future monitoring of this trade.

The rationale for management or conservation action on abalone, bêche-de-mer and dried fish products is less clear for various reasons. It appears from this analysis that while Hong Kong continues to play a major role in the world abalone trade, a large proportion of consumption in Chinese markets is supplied by domestic production. Trade monitoring would still be worthwhile to determine impacts to wild abalone stocks in other countries, but the provenance of abalone, i.e. wild or cultured, cannot be addressed through existing information, and would require detailed product certification procedures. The bêche-de-mer trade is of conservation concern in some areas (Bruckner *et al.* 2003), and Hong Kong remains the world's largest entrepôt for this dried seafood product. Although Hong Kong's consumption of bêche-de-mer appears to be declining, a increase in demand in Mainland China suggested by Hong Kong re-export figures appears to be key to both Hong Kong and global trade futures. Although not as widely publicized as shark fin, there are significant conservation concerns associated with some of the species, particularly croakers, used in the dried fish trade (Sadovy and Cheung 2003). Unfortunately, this study has only been able to provide a preliminary investigation of this trade because of the diversity of species and countries involved and the glaring lack of definition in dried fish trade commodity codes.

The focus of this study on the market places it in an opportune position to comment on the role of market forces in marine resource conservation. The dried seafood trader survey portion of this study reveals that while some dealers are involved in sourcing products overseas, and several are aware of calls for conservation action, all are primarily preoccupied with short-term impacts to sales and none considered stock sustainability to be their concern. These results extend little hope for motivating traders to advocate or practise self-initiated resource conservation measures as a means of maintaining their trade in the long-term. These same results, however, indicate the trade's vulnerability to faltering consumer demand. While the recent reported decline in sales is likely due to the regional economic recession rather than resource limitations, if this trend of decreasing demand is reinforced by a heightened consumer awareness, the traders' lack of loyalty to the business may result in a reduction of the global trade and a market-driven conservation benefit.

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