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A Preliminary Study on Local Species Diversity and Seasonal Composition in a Hong Kong Wet Market

Y.Y. SITU and Y.J. SADOVY

Department of Ecology & Biodiversity
The University of Hong Kong,
Pokfulam Road, Hong Kong S.A.R.
China

Abstract

A survey was carried out to obtain a representative list of size composition and seasonal variation in species composition of reef fishes being marketed in Hong Kong, taken from local or nearby waters in and around reefs, and sold either alive or recently dead. A total of 170 species, from 57 families was recorded from regular surveys between June 2002 and May 2003. It was estimated that a considerable proportion of the fish in this trade was in their juvenile phase; heavy fishing on juveniles potentially contributes to overfishing and should be reduced. Species composition changed from mainly tropical species in summer to predominantly temperate species in winter. Many of the species marketed include those formerly not considered to be suitable as food, which is a reflection of the overfished state of the local fishery. It is recommended that a better regulation of the live reef fish trade on local fish species and study on the biology of these species, be conducted to develop appropriate management initiatives for vulnerable species or life history phases.

Introduction

Hong Kong people consume a large amount of seafood. Fishermen catch fishes from Hong Kong local waters and nearby areas, but import 80% from sources throughout much of the Indo-Pacific region (Johannes and Riepen 1995, Wilson 1997). Due to a traditional Chinese preference for fresh fish, fishes in Hong Kong are mainly sold while still alive.

Most locally caught marine food fishes sold alive in Hong Kong associate directly or indirectly with reefs for all or part of their lives. Markets

selling local reef fishes include Ap Lei Chau, Aberdeen, Shau Kei Wan, Central Street, North Point. Most shop owners also own fishing boats, go fishing in the early morning, and sell the fish at noon and in the afternoon.

Overfishing represents the most serious threat to the diversity and abundance of reef fish communities in Hong Kong (Sadovy and Cornish 2000). Many of the reef fishes in the markets are juveniles, and the fishing gears used, especially gill nets, may also damage the coral communities reef fishes depend on. Many formerly important reef fishes have largely disappeared from local waters (Environmental Resource Management-Hong Kong Ltd (ERM) 1998).

Little is known of the local species caught and marketed alive or fresh in and around Hong Kong. Studies on the live fish trade have been done only on live reef fish imported into Hong Kong from the Indo-Pacific (Lee and Sadovy 1998, Sadovy et al. 2003) and on imported aquarium fish (Chan and Sadovy 1998) but not on locally caught species or on the impact of this local fishery. No studies have specifically targeted reef fish caught locally. There are also reports on catches of fish caught by Hong Kong fleets which fish mainly outside local waters (Agriculture, Fishery and Conservation Department, AFCD, Hong Kong). This 12-month study aims to provide a record of species diversity, species composition, sizes, prices and species changes by season of fishes taken from Hong Kong and nearby waters, including Dongsha and Xisha (Fig. 1).

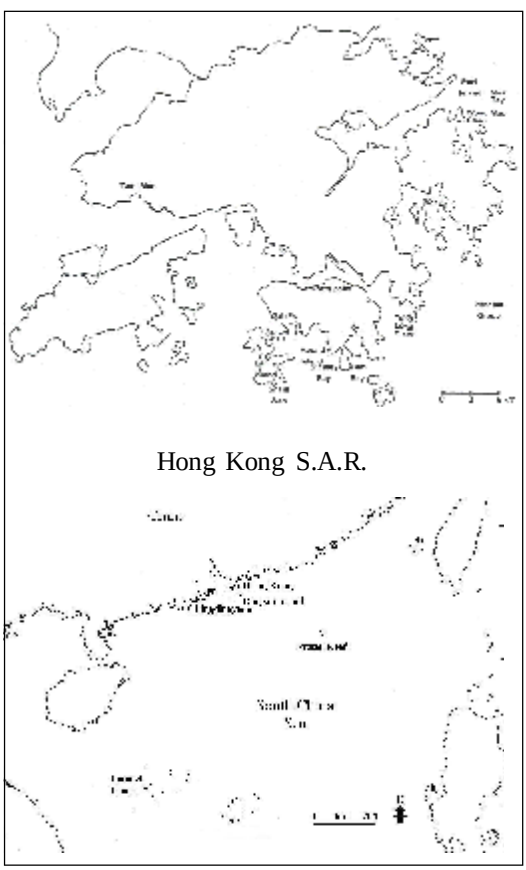


Fig. 1. Capture locations recorded around Hong Kong and adjacent waters

Materials and Methods

Sampling

From June 2002 to May 2003, a total of 54 visits were paid to Hong Kong local fish markets, including Ap Lei Chau, Aberdeen, North Point, Shau Kei Wan, and Central Street. Ap Lei Chau government market was selected for the present study because it has greater local fish species diversity than the other markets. Species were either identified in the market or purchased and returned to the laboratory for identification

to record all species. If the fish was too large to be taken back, or very expensive, pictures were taken using a digital camera for later identification. Each visit was made in the afternoon: the shop owners in the market typically went fishing in the morning, so there were more fishes for sale in the afternoon than in the morning.

The main targets of sampling were marine fishes believed to come from Hong Kong or nearby waters to obtain a representative view of the diversity of local fish species occurring in the market. Vendors were asked where they caught their fish, or whether they were from mariculture, since some fish caught in local waters may have escaped from mariculture. Local and nearby waters refer to those of the Hong Kong Special Administration Region and nearby areas of the South China Sea, including Dongsha and Xisha (Fig. 1). Only fishes that are alive or just dead were sampled; those placed on ice were not included to avoid double-counting, as frozen or chilled fishes may have been kept overnight.

The cumulative number of species recorded in consecutive visits (Table 1) was plotted to determine when sufficient samples had been obtained to represent the total diversity of species.

Identification and measuring

All fishes were identified to genus or species; *Gymnura* sp. (Gymnuridae), *Pseudosciaena* sp. A (Sciaenidae), *Scarus* sp. A (Scaridae) and *Scorpaenoides* sp. A (Scorpaenidae) could only be identified up to genus level. For fish brought back to the laboratory to assess their sexual maturation stage, gonads were removed and differentiated according to their sizes relative to body size (Table 2). Each fish was identified as male or female if possible, though not all the fishes could be sexed. From identification of sexual stage, size at maturity was determined. Alternatively, this was taken from Fishbase or by dividing maximum length by 2 to get a general idea of the size at sexual maturity (Sadovy 1996). Total and standard length and weight were measured.

To determine sizes of fish on sale, individuals of each species were categorized into 5 cm units during each visit using a ruler to aid in estimation. When the number of individuals of a species was too large to count, an estimate of the total number of individuals was used. For example, if there were several baskets of equal sizes, mostly of equal-sized fishes of a single species, the number of equal-sized individuals in one basket was counted and multiplied by the number of baskets, while the number of fish smaller or larger than this size category was also counted. Except where specified, the category of *platycephalids* refers to just two species, *Inegocia japonica* and *Platycephalus indicus* (Platycephalidae). For the most commonly seen 18

Table 1. Number of visits paid in each month

Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
13	0	4	7	8	6	0	4	4	3	2	3

species identified and surveyed from the beginning of the present study, numbers of individuals in different size categories recorded per visit in each month were plotted to show size composition and seasonal variation in abundance.

Most fishes were not kept overnight according to shopkeepers, so there were not double-counted in the survey. However, some large and expensive groupers may be kept for more than one day, so special attention was paid to avoid double-counting by asking shop-owners.

Capture location, fishing gear and retail price

Information on capture location and fishing gear was gained by talking to shop owners most of whom catch their own fish for the market. Several questions were asked: was the fish caught from local waters, had it been kept overnight before, where was it caught, and which fishing gear was used (hook and line, trawling, gill-netting, purse-seining, shrimp net, trap). Retail price of fish was requested; retail prices were similar in different shops in the same season, but may vary across seasons.

Results

From June 2002 to May 2003, a total of 170 species of local marine fishes belonging to 57 families were recorded from Ap Lei Chau government market during 54 visits. Of the 170 species recorded, the six most common were *Siganus canaliculatus*, *Sebastiscus marmoratus*, *platycephalids*, *Cephalopholis boenak*, *Abudefduf vaigiensis*, and *Nemipterus hexodon*. Figure 2 shows the cumulative number of species recorded with increasing number of visits. The curve indicates that a representative sample of species diversity in Ap Lei Chau market was obtained after about 50 visits (Fig. 2).

Species composition changed from mainly tropical species in summer to temperate species in winter. Tropical species, *Cephalopholis boenak* (Fig. 3a) and *Siganus canaliculatus* (Fig. 3b) decreased in number in colder winter months. *Sebasticus marmoratus* (Fig. 3c) was most frequently seen in summer, but disappeared before the spawning season in January and February (Ng 1999), with juveniles reappearing in great numbers in winter and spring. *Abudefduf vaigiensis* (Fig. 3d), *Terapon jarbua* (Fig. 3e), *Sargocentron rubrum* (Fig. 3f), *Scolopsis vosmeri* (Fig. 3g), and *Epinephelus bruneus* (Fig. 3h) decreased in winter months, while, conversely, *Plotosus lineatus* (Fig. 3i)

Table 2. Definitions of different sexual maturation stages

Definition	Description of sexual maturation stages
Immature	No gonad present
Undeveloped	Small proportion of gonad to body, without yolk
Developing	Small to medium proportion of gonad to body
Maturing	Medium size of gonad with a little yolk
Mature	Large size of gonad relative to body with some yolk
Ripe	Large, yellow with many eggs in female; large, white and angular in male

and *Nemipterus hexodon* (Fig. 3j) increased in winter. *Trachinotus blochii* (Fig. 3k) and *Chromis notata* (Fig. 3l) were more abundant in colder months.

In terms of sexual maturation, both adults and juveniles are sold. Most *Cephalopholis boenak* (Fig. 3a), *Abudefduf vaigiensis* (Fig. 3d), *Plotosus lineatus* (Fig. 3i) and *Scatophagus argus* (Fig. 3m) were sexually mature (table 3), while most *Siganus canaliculatus* (Fig. 3b), *Terapon jarbua* (Fig. 3e) and *Pseudorhombus arsius* (Fig. 3p) on sale had not attained sexual maturation. For *Epinephelus bruneus* (Fig. 3h), *Kyphosus cinerascens* (Fig. 3o), and *Trachinotus blochii* (Fig. 3k), no individual surveyed was mature. Most *Sargocentron rubrum* (Fig. 3f), *Nemipterus hexodon* (Fig. 3j), and *Chromis notata* (Fig. 3l) on sale were sexually mature.

Interviews were conducted with shop owners regarding capture location, fishing gear used (Table 4) and whether the fishes were from the wild or mariculture. Dangan, Po Toi, Tai Tam, Lamma Island, Stanley Bay, Sham Wan and locations further from Hong Kong such as Xi Sha, Dong Sha were the most frequent fishing areas mentioned (Fig. 1).

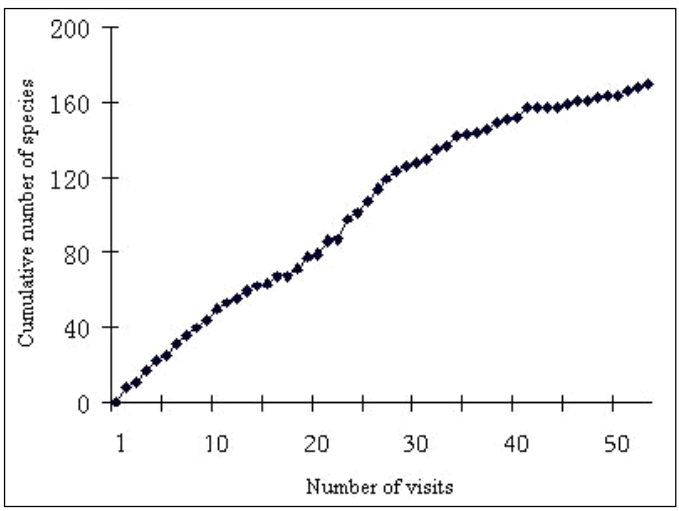
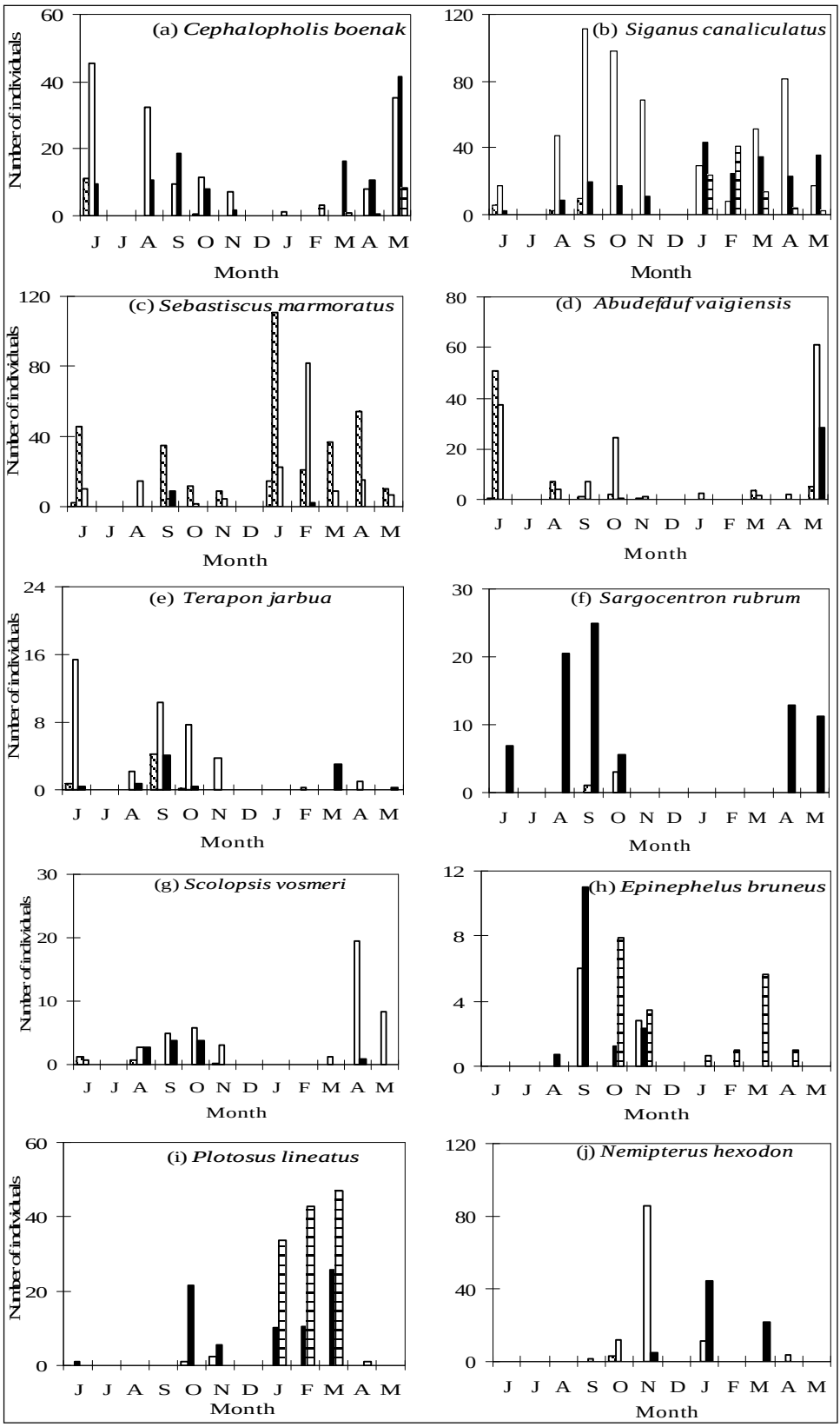


Fig. 2. Cumulative number of species recorded with number of visits

Table 3. Size at maturity and live retail prices of the most common 18 species recorded (T.L.: total length; S.L.: standard length; F: female; M: male; * data of size at maturity obtained by dividing maximum length by half; HK$7.8=US$1.0).

Species	Size at maturity(cm T.L.)	Live retail price (HK $•kg^{-1})
Cephalopholis boenak	F= 8-12 S.L.M=12-13 S.L.	50- 106
Siganus canaliculatus	18.5	58
Sebastiscus marmoratus	8	46
Abudefduf vaigiensis	*10	33
Terapon jarbua	*18	50
Sargocentron rubrum	*16	41
Scolopsis vosmeri	*12.5	41
Epinephelus bruneus	*64	132- 198
Plotosus lineatus	F= 14	33
Nemipterushexodon	10.5 S.L.	33
Trachinotusblochii	*55	Nil
Chromisnotata	*8.5	33
Scatophagus argus	F= 14 S.L.M= 11.5 S.L.	211
Platycephalids	*I. japonica*: *12.5*P.indicus*: 40	53
Kyphosus cinerascens	*25	Nil
Pseudorhombusarsius	F= 16- 17	40
Epinephelus quoyanus	18	Nil
Cryptocentrusfilifer	*7	Nil


(a) Cephalopholis boenak
(b) Siganus canaliculatus
(c) Sebastiscus marmoratus
(d) Abudefduf vaigiensis
(e) Terapon jarbua
(f) Sargocentron rubrum
(g) Scolopsis vosmeri
(h) Epinephelus bruneus
(i) Plotosus lineatus
(j) Nemipterus hexodon
Number of individuals
Month
J J A S O N D J F M A M

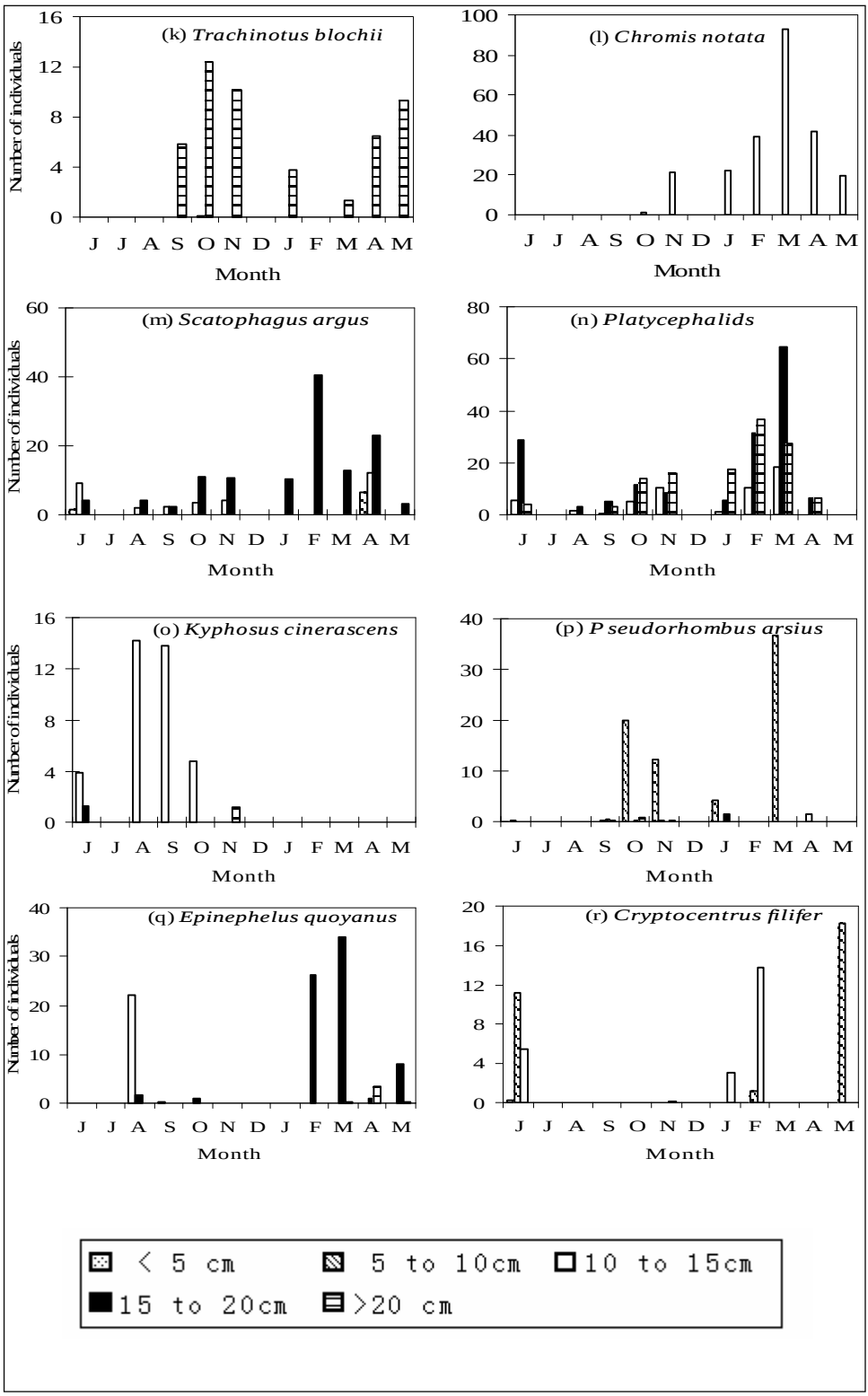


Fig. 3 (a-r). Mean number of individuals in each size category recorded per visit by month (no visits in July and September)

Table 4. List of species recorded as caught from reefs or near-reef areas and total number of individuals surveyed

Family and species	No. recorded	Fishing gear
Orectolobidae		
Chiloscyllium plagiosum	7	trawling
Dasyatididae		
Dasyatis zugei	24	
Gymnuridae		
Gymnura sp	1	
Engraulididae		
Coilia grayi	1	trawling
Muraenidae		
Gymnothorax favagineus	7	
Gymnothorax pseudothysoideus	13	
Gymnothorax reevesii	220	trap
Gymnothorax reticularis	2	
Plotosidae		
Plotosus lineatus	850	trawling
Synodontidae		
Trachinocephalus myops	3	
Antenneriidae		
Antennarius nummifer	1	shrimp net
Holocentridae		
Myripristis murdjan	9	
Sargocentron rubrum	451	hook and line
Mugilidae		
Liza macrolepis	2	net
Centropomidae		
Lates calcarifer	17	trawling
Percichthyidae		
Lateolabrax japonicus	17	trawling
Serranidae		
Cephalopholis boenak	1482	hook and line
Cephalopholis miniata	17	
Cephalopholis urodeta	19	
Epinephelus areolatus	11	
Epinephelus awoara	34	hook and line
Epinephelus bleekeri	10	
Epinephelus bruneus	289	
Epinephelus coioides	47	
Epinephelus fasciatomaculosus	57	
Epinephelus fasciatus	61	
#Epinephelus fuscoguttatus	104	
Epinephelus hexagonatus	1	
Epinephelus lanceolatus	1	
Epinephelus latifasciatus	1	purse-seining
Epinephelus merra	7	
#Epinephelus ongus	1	
Epinephelus quoyanus	11	trawling
Epinephelus trimaculatus	223	
Priacanthidae		
Priacanthus macracanthus	5	
Apogonidae		
Apogon dispilus	4	trawling
Apogon doederleini	23	trap
Apogon fleurieu	97	trawling
Apogon pseudotaeniatus	89	trap
Archamia fucata	1	
Sillaginidae		
Sillago japonica	65	
Carangidae		
Selaroides leptolepis	21	
Trachinotus blochii	262	
Leiognathidae		
Leiognathus brevirostris	3	
Gerreidae		
Gerres filamentosus	12	
Sciaenidae		
Johnius macrorhynus	43	
Pseudosciaena sp. *A*	1	trawling
Mullidae		
Mulloidichthys flavolineatus	1	
Parupeneus barberinus	1	
Parupeneus ciliatus	16	
Parupeneus multifasciatus	119	
Upeneus tragula	1	
Pempheridídae		
Pempheris oualensis	9	
Kyphosidae		
Girella melanichthys	1	trap
Kyphosus cinerascens	242	
**Kyphosus lembus*	2	trap
Microcanthus strigatus	41	
Lutjanidae		
Lutjanus argentimaculatus	1	
Lutjanus bohar	1	
Lutjanus johnii	105	hook and line shrimp net
Lutjanus kasmira	2	shrimp net
Lutjanus malabaricus	28	
Lutjanus rivulatus	1	
Caesionidae		
Pterocaesio tile	5	
Haemulidae		
Diagramma pictum	112	
Hapalogenys mucronatus	13	
Parapristipoma trilineatum	36	
Plectorhinchus cinctus	4	
Plectorhinchus gibbosus	66	
Pomadasys kaakan	25	trawling
Pomadasys maculatus	1	trawling
Teraponidae		
Pelates quadrilineatus	115	
Rhynchopelates oxyrhynchus	1	purse-seining
Terapon jarbua	380	
Terapon theraps	23	
Drepanidae		
Drepane punctata	241	
Nemipteridae		
Nemipterus hexodon	964	
Scolopsis lineatus	5	
Scolopsis vosmeri	273	trap
Sparidae		
Acanthopagrus latus	12	hook and line
Pagrus major	55	
Rhabdosargus sarba	23	
Lethrinidae		
Gnathodentex aureolineatus	3	
Lethrinus haematopterus	139	
Lethrinus nebulosus	94	
Lethrinus ornatus	23	
Ephippidae		
Platax orbicularis	20	
Scatophagidae		
Scatophagus argus	709	trap
Chaetodontidae		
Chaetodon auriga	28	
Chaetodon auripes	1	
Chaetodon modestus	19	
Chaetodon speculum	1	trap; net
Chaetodon trifasciatus	1	trawling

Table 4 continued...

Table 4 continued...

Family and species	No. recorded	Fishing gear
Chaetodon wiebeli	168	
Heniochus acuminatus	3	
Pomacanthidae		
Chaetodontoplus septentrionalis	1	trap
Pomacanthus annularis	2	trap
Pomacentridae		
Abudefduf sordidus	23	
Abudefduf vaigiensis	1391	
Amphiprion clarkii	6	
Chromis notata	805	trap
Dascyllus trimaculatus	4	net
Neopomacentrus bankieri	9	
Cirrhitidae		
Cirrhitichthys aureus	9	
Cheilodactylidae		
Cheilodactylus zonatus	2	net
Cepolidae		
Acanthocepola krusensterni	3	
Labridae		
Anampses caeruleopunctatus	14	
Bodianus diana	1	net
Cheilinus chlorourus	100	
Choerodon anchorago	22	
Choerodon azurio	7	trap
Choerodon schoenleinii	2	
Epibulus insidiator	2	
Gomphosus varius	1	trap
Halichoeres nigrescens	113	
Hemigymnus fasciatus	1	
Hemigymnus melapterus	12	
Pseudolabrus eoethinus	4	trap; net
Pteragogus enneacanthus	26	
Stethojulis interrupta	2	
Thalassoma lunare	37	
Scaridae		
Calotomus carolinus	1	
Chlorurus sordidus	191	trap
Hipposcarus longiceps	1	net
Scarus sp. *A*	31	
Scarus diminiatus	1	
Scarus forsteni	1	
Zanclidae		
Zanclus cornutus	2	
Acanthuridae		
Acanthurus dussumieri	3	
Acanthus olivaceus	2	
Acanthurus triostegus	5	
**Naso lituratus*	1	
Prionurus scalprus	1	
Siganidae		
Siganus canaliculatus	4415	hook and line; trap; net
Siganus puellus	25	
Siganus punctatus	112	trap
Siganus spinus	2	
Gobiidae		
Acentrogobius caninus	13	shrimp net
Cryptocentrus filifer	260	shrimp net
Parachaeturichthys polynema	66	trawling
Trypauchen microcephalus	1544	
Blenniidae		
Petroscirtes breviceps	1	
Uranoscopidae		
Ichthyscopus lebeck sannio	1	trawling
Scorpaenidae		
Pterois volitans	3	net
Scorpaenodes sp. *A*	645	hook and line; trap
Scorpaenopsis macrochir	145	
Sebastiscus marmoratus	2839	trap
Trachycephalus uranoscopus	2	trawling
Platycephalidae		
Platycephalids	1598	trawling
Dactylopteridae		
Dactyloptena orientalis	10	trawling
Paralichthyidae		
Pseudorhombus arsius	392	trawling
Soleidae		
Zebrias quagga	251	trawling
Cynoglossidae		
Cynoglossus itinus	2142	trawling
Paraplagusia bilineata	210	
Balistidae		
Rhinecanthus aculeatus	1	
Monocanthidae		
Aluterus monoceros	6	
#Acreichthys hajam	1	
Cantherhines pardalis	1	
Monacanthus chinensis	107	net
Stephanolepis cirrhifer	127	
Ostraciidae		
Lactoria cornuta	1	net

*New records for Hong Kong; # questionable records for Hong Kong, i.e. probably mariculture-sourced

Regarding fishing gear, trap, hook and line and trawling were most frequently used. For questions about which species were maricultured, shop owners reported mainly groupers and snappers. Due to local residents' preference for wild-caught fishes, however, shop owners may say their fishes are from wild because these fetch higher prices, even if they are actually maricultured (personal observation: some maricultured fish have damage on scales, eyes or fins, possibly caused by mariculture).

Discussion

During the 12-month market survey from June 2002 to May 2003 inclusive, a local Hong Kong government market Ap Lei Chau government market was found to be extremely diverse in locally caught reef fishes, including some species considered rare in Hong Kong waters; for example, *Epinephelus lanceolatus* and *Lutjanus kasmira*. *Kyphosus lembus* and *Naso lituratus* were new records for Hong Kong. *E. fuscoguttatus* and *E. ongus* have not been recorded from Hong Kong before, and are considered to be 'questionable records' since they have probably been purchased from mariculture zones after imports, or have escaped from them; *E. fuscoguttatus* is frequently imported as part of the live reef fish trade (Lee and Sadovy 1998).

Of the 170 species recorded, some were not the main target fishes, and many were sexually immature. From the survey, fish sold in this market were generally small, most were in their juvenile phase, such as *E. bruneus*, *Terapon jarbua*, *Pseudorhombus arsius*, and *Kyphosus cinerascens*. Since most fisheries management aims to avoid capture of juveniles, the small sizes and high numbers of juveniles in this market deserve further study to address concerns on overexploitation.

A seasonal change of species composition in the market was noted in this study, with tropical species dominating in summer, while temperate species in winter. This pattern may be explained by changes in fish abundance in response to temperature and/or seasonal change in fishing activity patterns which is tightly connected with fish abundance, market price and cost of fishing (Fig. 4). Market price and cost of fishing do not vary much seasonally in Hong Kong (Cheung, *pers. comm.*), and for seasonal consumer demand, only an increase in consumer demand during Chinese New Year occurs. In underwater visual censuses of fish assemblages associated with shallow coral communities in Hong Kong, tropical species were less active in winter (Cornish 2000), probably making them less catchable to liners, gillnets and cage traps, which are the main gear types for live reef fish in Hong Kong local inshore waters (Cheung, *pers. comm.*). It was suggested that the seasonal change in species composition is solely due to seasonal changes in fish abundance.

Live retail prices of common fish species in this market (Table 3) during the study period ranged from 33 to 211 HK $\$ \cdot kg^{-1}$, and were generally much lower than the market prices of some traditionally high-valued live

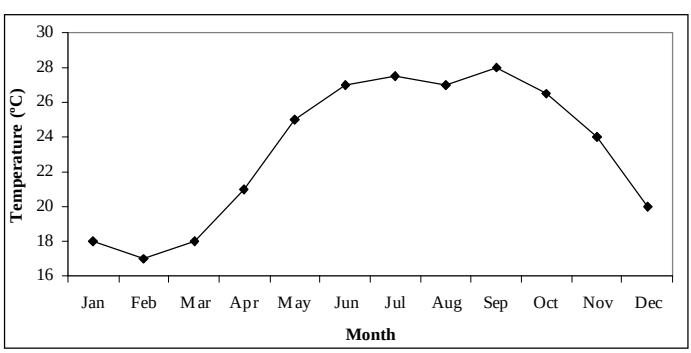


Fig. 4. Monthly mean sea-surface temperature, 1975-98. (Hong Kong Observatory, 1998)

reef fishes, such as *E. akaara*, *Cromileptes altivelis*, *Plectropomus leopardus* and *Cheilinus undulatus* (AFCD, Hong Kong). The most valuable common fish species in this market survey was *E. bruneus*.

According to ERM (1998) and Cheung (2001), a significant reduction in large high value food fish such as groupers and snappers occurred between 1950 and 1997 in the Hong Kong fishery. Total fishery catch value has been sustained by moving towards less valued species, including some formerly not sold as food, but as bycatch historically used as food for fish in mariculture (Wilson 1997), such as *Leiognathus brevirostris*. The present study of one important local market has similarly indicated that large groupers and snappers are rare, while low-valued small fish species dominate the market. Cheung (2001) proposed that the expansion of fishing effort, mainly bottom trawling, was the major cause of the change in the fishery.

Research on reef fish food trade along the South China Coast is scant with very few published studies. Likewise in Hong Kong, there has been little study on the species diversity of locally caught and retailed reef fish live or dead. In one study, a Hong Kong fishery resources survey conducted in 1996-1997 by trawling, stock assessments of 17 important commercial species (of which 13 were fish) were conducted. It was estimated that 85% of the total inshore resource biomass in Hong Kong was comprised of pelagic species, and of the 17 species studied, 12 were over-exploited while the remaining small, low-value, high-turnover species are fully exploited. Of the 17 species, 3 were recorded in the present study: *Siganus canaliculatus*, *L. brevirostris* and *Apogon fasciatus*, all considered to be over-exploited from the results of the previous study (ERM 1998). The government Fish Marketing Organization has data on the weight and prices of fish landed that come from both within and outside Hong Kong. However, fishermen are not required to land live fish under this organization, few species are identified to species level, and most landed fish are from non-reef trawl fisheries and do not represent the local reef fish component. These statistics, therefore, say nothing about local reef fishery species, which are unmonitored in Hong Kong. The biology of Hong Kong's commercial species is largely unknown, and the effect of fishing on them needs more research, a good start may be on the biology of the most valuable and most abundant species. Though this study concentrated on only one local reef fish food market, it serves as a preliminary description on species composition and seasonality in the local reef fish food trade for live and fresh fish.

Because of high demand and years of overfishing, larger groupers and other large fishes are no longer common (Chan 2000; Sadovy and Cornish 2000). Most fishes that are sold are small. In the market surveyed in this study, groupers were mainly juveniles, or adults that had been maricultured. Other high-value species being maricultured include snappers (Lutjanidae). Mariculture satisfies some of the demand from consumers for fresh fish. However, as some mariculture in Hong Kong is operated through capturing wild-caught juveniles for grow-out and uses trash fish for feed (Sadovy and Lau 1998), it poses yet another pressure on fish populations, since recruitment is needed to maintain the population.

Active fishery management is lacking in Hong Kong (Cheung 2001). The Fisheries Protection Ordinance (FPO, Cap. 171 1964) is the relevant legislation, however, the statutory power provided by the ordinance is not used (Cheung 2001). Management of local reef fisheries sources is needed. The FPO is being revised to incorporate a fishing permit system for all commercial fisheries in Hong Kong, although no limit to permit number is planned (Cheung 2001). In view of the large amount of juvenile fish being exploited according to this and other studies (ERM 1998, Cheung 2001), mesh size regulations could protect small reef food fish. It was suggested based on the stock assessment of inshore fishery resources, that the catches of larger and slower-growing species might roughly be doubled with optimal management, while overall, the long term yield for the fishery might be roughly doubled by increasing mesh size. However, it may be impractical to enforce this regulation in Hong Kong, given limited enforcement capacity.

Establishing Marine Protected Areas (MPAs) could be another choice to protect reef fish and allow some recovery. The Marine Parks Ordinance enacted in 1995 (Cap. 476), provided for the designation, control and management of marine parks and marine reserves. Bottom trawling is banned in all marine parks and all fishing is banned in one marine reserve; gillnetting and purse seining are still allowed for those with license (these licenses apply to Marine Parks used only to allow for indigenous use). But the total area of three existing Marine Parks and one Reserve is only 21.6 km^2, just 1.19% of Hong Kong waters, with only 0.2 km^2 as no-take area (Cheung 2001). The effectiveness of Marine Parks in protecting reef fish in Hong Kong, therefore, under current conditions, is poor (Cornish, *pers. comm.*). In a long-term and comprehensive coral fish monitoring programme from 1997 to 2003, the diversity, abundance, and biomass of target coral fish species declined in Hoi Ha Wan Marine Park after being designated in 1996, while those in Tung Ping Chau Marine Park showed no change after the park was designated in 2000. It is suggested that fishing activity in Marine Parks may be the main reason for the observed decline or lack of fish species (Cornish, *unpub. data*). There are currently about 300 fishermen holding permits to fish using hook and line, traps or gill nets in Hoi Ha Wan and Ping Chau Marine Parks (AFCD 2004), so fishing pressure is considerable.

Setting up larger and more MPAs as 'no-take' zones could facilitate resource recovery of reef fish, by allowing the fishes to grow bigger and reproduce (White 1988, Polacheck 1990, DeMartini 1993, Dugan and Davis 1993). The propagules produced from protected stocks can migrate to surrounding areas and thus maintain productivity and insure against stock collapse (Bohnsack 1996).

Conclusion

A 12- month survey recorded 170 local fish species belonging to 57 families in a Hong Kong wet market. Species composition has shown seasonal variance, from mainly tropical species in summer to be dominated by

temperate species in winter. Many species on sale are on their juvenile stage, and some are low value species that were formerly not considered as food fish. It is suggested that further study and better regulation on local reef fish food trade be conducted.

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