

Resilience of an inshore fishing population in Hong Kong: Paradox and potential for sustainable fishery policy

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ABSTRACT

The existence and dilemmas of metropolitan fisheries have been overlooked in research on the resilience of coastal marine socio-ecological systems. Yet, they could produce a model of sustainable fisheries with significant global impact. To fill that research gap, this study investigates an inshore fishery population that has sustained itself within Hong Kong's rapid urban development, seeking to understand the reasons for its survival. The results indicate that the values of self-reliance and entrepreneurialism exacted by fishing enabled the fishers to make necessary adaptations and reposition themselves in mariculture and service industries. These new ventures, while retaining marine-based livelihoods, draw the fishers away from fishing activities. The paradox of this value-based resilience of a metropolitan fishery is discussed for its potential to generate policies to strengthen linkages among the fishers' business activities and to create a sustainable fishery model useful in other contexts.

1. Introduction

The inshore waters of Tokyo, New York and Hong Kong were once substantial fisheries, but only vestiges remain after they were degraded by expansion of the built environment, infrastructure, land reclamation, pollution, and overfishing [13,65,59,72,89]. Fisheries research has overlooked these metropolitan inshores in favour of addressing the urgent sustainability issues confronting small-scale and industrial fisheries typical to rural peripheral areas and the high seas. There are reasons, however, not to forsake metropolitan fisheries as inevitably lost to rural-urban transformation. Foremost, these metropolises are endowed with greater occupational diversification opportunities and greater resources available to support sustainable fisheries. Metropolises can provide a new model of a sustainable fishery—a counterpoint to their roles as markets that commodify fish resources and induce industrial fishing. A sustainable metropolitan inshore fishery may also offer insights into the potentials and limitations more typical to small-scale fisheries with regard to social reproduction, occupational diversification, identity and values, and adoption of sustainable practices.

The vestigial metropolitan fishery investigated in this paper is the inshore fishery of Sai Kung (SK) in Hong Kong. The fishers of this area followed the familiar path of overfishing their inshore and then embarking on more distant exploitation. Although HK's offshore fleet

remains large at 4000 fishers, SK's fishers have retreated to their inshore, continuing fishing, but improving their well-being through alternative businesses. Values of self-reliance and entrepreneurialism have been key to adapting to the high-cost, high-income metropolitan economy and to the fishing community's social reproduction.

The paper begins by situating SK fishers within a degrading marine ecosystem and the challenge of an enveloping metropolis. A theory section explains why the SK fishers' dilemmas should be addressed through a resilience and coastal marine socio-ecological system (CM-SES) framework [45,58], why values as slow-moving variables are important [14,42] and how a values perspective can reveal new insights for the livelihood approach to fishing communities [96,36,40]. The methodology section explains the evolution of the research strategy from a deductive approach focused on revealing common pool governance mechanisms [37,74] to using grounded theory methodology [43] in order to reveal new mechanisms of resilience. A results section shows how entrepreneurial values originated, then underpinned several livelihood adaptations. The penultimate section discusses the paradoxes for marine policy when the values that underpin a fishing community's resilience to metropolitan pressures weaken linkages to fishing. The conclusion considers implications of SK's case for other fisheries.

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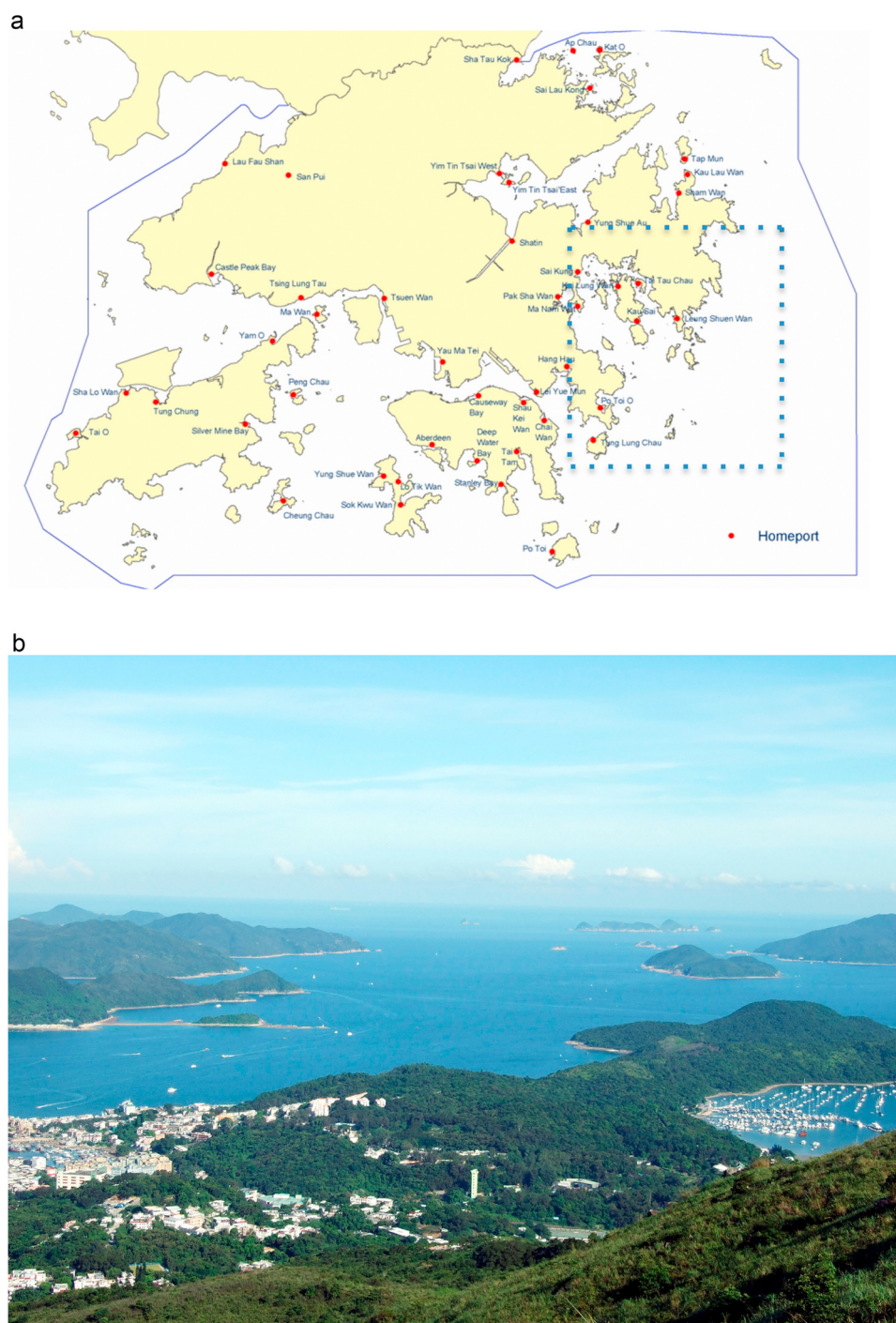


Fig. 1. (a) The Sai Kung Fishery within Hong Kong's Territorial Waters. (b) Sai Kung Town (lower left) and Port Shelter Bay.

2. Context: limited fisheries management and dramatic urban development

The fishery of Sai Kung is set in a large bay on the east side of HK's New Territories. The bay is ringed by nine traditional anchorages/homeports with the largest, Sai Kung, located at the Bay's northwest (Fig. 1a and b). Most fishers now live on shore in the town of SK, which has become a gateway to countryside recreation and a bedroom community. The population of 200 fisher households (fisher association president estimate) must generate livelihoods in the context of living and working among SK's 20,000 people and HK's burgeoning metropolitan economy of 7 million (Fig. 2). Table 1 highlights

metropolitan pressures that test the fishers' resilience: a rapidly expanding per capita GDP that fishers must match; increasing educational and professional opportunities for their children; skyrocketing home prices; and reclamation of fishing areas. Below, the pressures confronting all HK's fishers are described first, before returning to SK.

Fisheries management didn't exist in HK before World War II, but shortly thereafter, to ensure food security and improving living standards, the government supported fishers with loans and mechanization and established a marketing board and cooperatives. By 1958, 2358 of 8520 boats were mechanized and many fishers became relatively well-off [90]. Yet to keep pace with the demand for fish and the escalating costs of living in a tiger economy, fishers overexploited the resource.



Fig. 2. Timeline of events related to Hong Kong's development, its fishing industry, and Sai Kung's development and fisheries (after Bunce et al. [19]).

The inshore waters were depleted by the 1960s prompting the government to encourage offshore fishing. Soon HK became an Asian leader and harboured the largest fleet in the British Empire [100]. In what remained of the inshore, fishers shifted to smaller and faster growing species [89].

Decreasing stock reduced fleet efficiency from 480 kg/kw in 1985–200 kg/kw in 2000, where it remained through 2008 [83]. The fisher-population declined alongside overexploitation, especially as youth lost interest in the livelihood. To support remaining fishers, in 1995 the government allowed employment of low wage Mainland China deckhands, provided they were confined on-board. Most worked in the offshore fleet and some on fish farms; demand peaked at 8000 and fell to 4400 by 2015 [5,53,83].

Government studies in 1997 [83] and 2006 confirmed over-exploitation of the fisheries, prompting introduction of artificial reefs and controls over destructive practices. Effective control only materialized in 2013 when the government banned trawling, limited entry and restricted engine size and equipment. Government, NGOs and academics worked to facilitate provision and acceptance of alternative livelihoods [89,91,105]. Several of the options are similar to those in the livelihood literature [20,23,24,50,68], but most were proffered as

employment rather than business opportunities. A few alternatives were inspired by the innovative SK fishers.

As with all HK's fisheries, SK faced urban development, pollution and reclamation pressures, and compulsory education for children (Fig. 2). The British also requisitioned fishing areas for target practice and reservoir construction. Road access in the 1950s increased development and in the 1970s SK became a bedroom community and gateway to the countryside. Neither fishers nor government considered fishery co-management, but NGOs strove to convert the fishery into a marine protected area in the early 2000s. That initiative was rebuffed but small no-anchor and no-fishing zones were established. SK fishers benefit from living in a recreation-conducive environment featuring volcanic remnants (UNESCO geological park in 2009), beaches, bays and more than 80 species of coral. These attributes proved valuable as fishers adapted livelihoods to metropolitan expansion.

3. Theory: resilience in a metropolitan coastal marine socio-ecological system?

In sustaining marine livelihoods within the HK metropolis the SK fishers have demonstrated the persistence, adaptability and

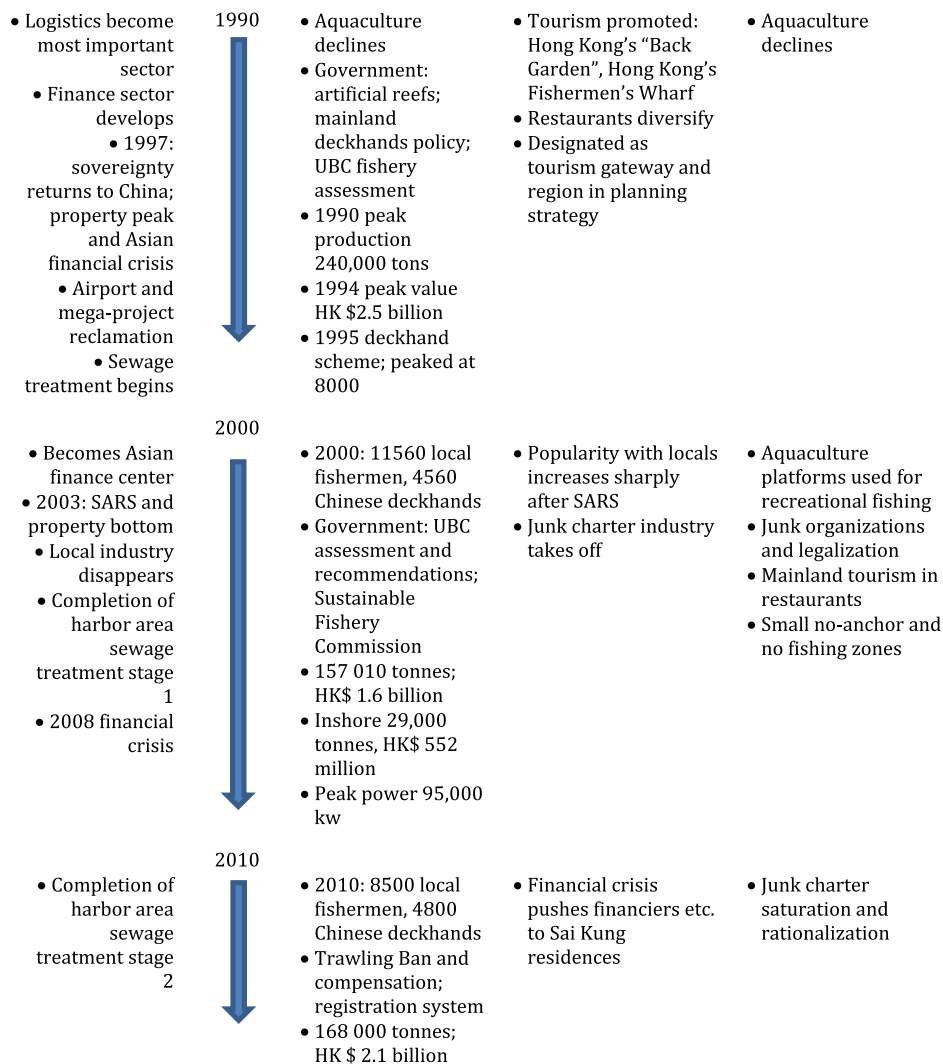


Fig. 2. (continued)

transformability that invite a resilience-based interpretation of their accomplishment [42,101]. This section discusses the resilience framework used for the research, perspectives on resilience of particular relevance and the study's contributions.

A foundation for the resilience interpretation is the CM-SES

perspective because it examines the mutual dependency between marine ecosystems and fishing communities. Moreover, with its foundation in ecosystem resilience, CM-SES retains this research's goal of determining whether a metropolitan fishery can offer promise as a sustainable fishery model. Typically, the health of the ecosystem is

Table 1
Hong Kong Development Indicators 1950–2015.

	Per Capita GDP (US\$) ^a	Tertiary Enrollment (% of school leavers) ^b	Property Domestic Price Index (1999 = 100) ^c	Land Reclamation (cumulative ha) ^d
1950		≤ 5		700
1960	428 (vs US 17,000)	≤ 10		1000
1970	960	≤ 10		1500
1980	5700	≤ 15	19.9	2500
1990	13,500	≤ 20	44.8 (1997 peak: 163.1)	5000
2000	25,800	≤ 30	89.6 (2003 bottom: 61.6)	6000
2010	32,500 (vs. US 48,000)	≤ 70	150.9 (2015 peak: 296.8)	6800
2015	42,400	≤ 70	Peak: 296.8	69.54 of Hong Kong's 1105.69 sq km

^a World Bank.^b United Nations.^c Statistics Department (HK).^d Lands Department (HK).

considered multi-dimensionally, that is, challenges to resilience derive from pollution, land reclamation, fishing, invasive species, climate change, and so on [27,30,49,61,67,71,93]. That said, most studies emphasize fishing pressure as principle disrupter of marine ecosystems because of the large impact of fishing and because the SES depends on marine ecosystem viability. As this study concerns metropolitan pressures, all disruptions to the CM-SES are considered.

Although resilience in any situation will be multifaceted, the key process is the need for exploiters and related socio-economic institutions to transform to reduce degradation of the ecosystem. In particular the CM-SES perspective emphasizes the need for fisheries management to incorporate co-management systems [45,29,57,58,64,93]. That perspective, in turn, is based in common pool resource (CPR) theory and its proposition that resource sustainability is enhanced through collective self-governance [37,73,74]. The CPR-co-management proposition of enhanced sustainability has been confirmed in numerous studies of CM-SES, small-scale fishery, community-based fishery and inshore fishery situations ([48,93]. Leadership, catch shares, social capital and cohesion, protected areas, self-enforcement are described as the governance practices most in need of introduction (see also [28,58]). Increasingly, social processes, such as networking, knowledge generation, participation and using local knowledge are recognized as integral to co-management [45].

Despite the incorporation of social science perspectives into co-management, many authors claim that combining ecological and social resilience in a CM-SES remains problematic [4,10,18,34,55,61,76,87,84]. Of note are the consequences for individual and fisher communities when adjusting to the demands of fishery management. For that reason, the sustainable livelihood approach (SLA) evolved to consider resilience from the perspective of fishers as individuals, families and communities. SLA is important to this study because of the study's premise that a sustainable fishery requires a sustainable fisher population.

The SLA is a development perspective, examining vulnerability to and causes of poverty in small-scale fisheries (primarily, tropical and developing countries) and exploring institutional and occupational changes that can improve fishers' livelihoods [8,9,40]. The well-being approach extends SLA through consideration of human agency, identity, community and other values that expand expectations of what a resilient CM-SES should provide [100,35,36]. While the SLA and well-being perspectives are principally concerned with developing country situations, the small-scale fishery (SSF) literature brings similar perspectives to European, North American and East Asian developed country contexts [55,52,88,102].

Several strands of the prioritization of "people's social and economic activities" [9], 758) found in the SLA-SSF perspective are relevant to this investigation. First, culture, identity and values are identified as both ends and means to resilience through the literature's emphasis on fishing's contribution to creating a sense of place and identity for fishers, families and community [2,62,66,95,102]. In turn, the embedded values, local knowledge, social capital and well-being derived from the place and its community support resilience. Most studies show that this resilience is withering in the face of fishery degradation and socio-economic change. The keystone contribution this research offers to the SLA-SSF literature is a perspective on values distinct from that binding culture and identity to fishing ([76]).

To foreshadow the research results, when faced with ecological degradation and rapid socio-economic changes, the SK fishers not only adapted their marine expertise, but also drew upon entrepreneurial acumen to develop new businesses. Their adaptability originates in the values of self-reliance and entrepreneurialism generated in the fishing livelihood, but is not limited to it. Once generated, these values directed the fishers to assume that they should remain self-supporting and provided the confidence to enter new industries. The potential of values to support resilience was suggested by Folke et al. [42], who called for further investigation. The emphasis on values, moreover, is supported

by designation as a slow-moving variable, one of the key principles of resilience [14]. Jones et al. [56], refer to Rokeach [79] to define a value as "a belief pertaining to desirable end states or modes of conduct that transcends specific situations, guides selection or evaluation of behaviour, people, and events, and is ordered by importance relative to other values to form a system of value priorities." Adopting that perspective to examine SESs, Jones et al. [56] place values at the base of an inverted hierarchy of behaviour from which attitudes and norms, intentions and behaviour expand and manifest.

This study focuses on values as a driver of economic outcomes, rather than on identity and culture and is interested in how the values of fishers may result in diverse economic outcomes—aligned or unaligned with fishing. It is a focus supported by institutional economists who have determined that values generated by an event at a specific time can persist through generations and shape later day economic activities irrespective of sector. This value persistence influences social constructs such as trust, gender roles and frugality, and impacts economic outcomes positively and negatively [6,7,47,70,98]. The impact of value persistence on economic outcomes reinforces the recognition by the social sciences of the power of embedded values to shape behaviour and livelihood choices [46,69,77].

The second strand of the SLA-SSF approach, integral with value persistence, is social reproduction. Fundamentally, a fishery needs a population of fishers, but declining fisher populations and difficulty of recruitment afflict fishing community continuity and fisheries, particularly in developed countries [22,86]. Fishing families have long been considered the primary means of socially reproducing fishing livelihoods because they bring offspring into the profession and transfer values, skills, knowledge, and hardiness [89,97]. The community also transmits skills and mores, yet agency allows for interpretation of family and community influence [10,11,63,97]. Now as fishing children and their desire to follow their parents decline, the difficulties of recruiting from outside the culture into the occupation are becoming recognized, and include cultural, expertise and financing [103]. The social reproduction perspective, on one hand, reinforces the research premise that a sustainable fishery requires a sustainable fisher population and the goal of determining the means for the population's resilience. On the other, it cautions that fishing expertise needs to remain incorporated into the social reproduction process, and not abandoned as entrepreneurial and self-reliance values take SK fishers into new businesses.

Third, the sustainability of values and population would not be possible without occupational diversification and alternatives. Drawing from the SLA-SSF literature Coulthard (2012) suggests three main options for fishers adapting to a decline in their resource: remain fishing and get by with less (potentially with family members diversifying incomes); diversification into complementary occupations such as farming; and exit to alternative livelihoods. Getting by with less (and rule breaking) are paths taken by SSFs in developing countries [16,25,75];, but an option more frequently taken by fishers with the greater resources of developed countries is diversifying the portfolio of species caught ([31]). The diversification strategy is becoming increasingly popular, especially tourism [20,23,24,50,68,78,82,81,99]. Diversification strategies maybe linked to fishing (e.g. recreational fishing, seafood products) or diverge from fishing (e.g. scenic tours, crew transport and provisioning). Much attention to the exit strategy focuses on the thresholds of livelihood degradation (e.g. degree of catch decline) Coulthard [36] and Blythe [16] warn that when this threshold is crossed "the relationship between fishers and fish would be broken." The viability of diversification and exit to alternative livelihoods is related to resource dependency, geographic isolation and conditions (e.g. for tourism), and economic diversity of fishers' locations [17,54,80,94].

A few of the diversification and alternative occupation options pursued by the SK fishers are familiar to the literature, although the degree of experimentation, profession switching and diffusion through

the population may be novel. That said, more important than the options for diversification and alternatives, are the values of self-reliance and entrepreneurialism that enable fishers to make multiple adaptations. The values sustain adaptations through generations and diffuse them within a generation. Related to occupational diversification and alternatives is a fourth strand of research linked to the SLA-SSF literature, which deals with encroaching urbanization and rising cost of living that threaten fisher livelihoods. This perspective is primarily concerned with impact of increased tourism-oriented development on rural fishing communities. Negatively, the spread of amenity migrants and tourist activities to a fishery area pushes up land prices and other costs of living, but positively, serving amenity demand offers diversification and alternative livelihood opportunities [33,92]. In Sai Kung these impacts are amplified. Metropolitan pressures inflate land values and cost of living, while being immersed in a huge and wealthy urban population provides the fishers with many opportunities to repackage their marine skills.

In summary, the research adopted CM-SES/resilience theory because it makes the essential connection between ecological and social well-being. It establishes a link between the fishing population's continuity and the potential for them to support a sustainable fishery. That said, as the focus of the research is explaining how a fisher population can survive in a metropolitan situation, it adopts the tenets of the SLA. The research's key theoretical contribution is to delve deeper into the role of values as the driver and facilitator of the livelihood options pursued by the fishers.

4. Methodology: linking value outcomes to origins

Research began as a deductive investigation using an interview survey guided by common pool resource (CPR) concepts [37,73,74], resilience [14,42] and CM-SES theories [45,48]). The strategy was to determine what methods of collective self-governance fishers used in the past and their willingness to engage in co-management for a sustainable fishery. Restaurateurs were also interviewed to explore the potential for sustainable fisheries by adding value to the local catch. Initial interviews, however, revealed not only that CPR precepts were inapplicable, but also that survival of the fishing community or rather the water-borne community depended more on livelihood transformation than prolonging fishing. Research was, therefore, refocused on perceiving shifting patterns in livelihoods and how they were facilitated and experienced. Hence, qualitative interviews, rather than guided by CPR concepts, were reoriented to a grounded theory methodology (GTM). GTM respects the intentions and actions of the subjects in order to understand what social processes are occurring and to build theory on that foundation. It is an especially useful approach when there has been little examination of how context affects peoples' lives [38].

In this investigation, it was necessary to push CPR thinking into the background and prioritize building theory on how fishers have actually been adapting to urbanization. In GTM, analysis and theory building occur concurrently, that is, as interview data is collected it is coded to reveal new phenomenon, interrelations and patterns. Identifiable categories of behaviour can then be determined, the framework for investigation reconsidered and new routes for investigation taken [43]. The use of open ended questions allows this reconsideration to take place in the midst of interview as well [39,44]. In this research, such theoretical sampling was used to ask fishers about their livelihoods, codify their activities and especially to determine what was old and new in their activities: what they did in earlier livelihoods, what was carried over into new livelihoods, and what innovations were developed. Key themes within the codification and analysis process were identifying the professions and skills involved, the evolution of entrepreneurialism, changes to family structure, changes to income and well-being and social adjustments such as education. From that analysis livelihood categories were identified and those became the focus for describing the steps and actions taken in adaptation to the enveloping

metropolis.

Interviewees identified categories as they described their livelihoods and those of acquaintances, revealing knowledge of the community, industry and locality. If interviewees suggested new categories, follow-up interviews were pursued with people in those livelihoods. These categories were identified concurrently, when after 6–12 interviews the data became conceptually saturated, the research was reconsidered as a whole and a new investigation route chosen. The main categories identified were: initial fishing livelihood, mechanized fishing livelihood, fish farming and service industry (sub-categories of junk charters and restaurants). In accordance with resilience theory [41], categories subsequent to fishing are considered adaptations to environmental change.

Eventually, a consistent and powerful process that links these stages, evolved through the analysis. The values of self-reliance and entrepreneurialism were a constant referent and stimulus to all adaptations, generating a core category for the theoretical framework. Thus in addition to the first level empirical livelihood categories, this core category second level generalization, while a more constructivist application of GTM [21], allows for a broader deductive use of the research results (1978). After this core category began to emerge, verification was sought by reviewing past interviews, asking specific questions in new and repeat interviews and reevaluation of the literature.

Research began with government officials and fishing association leaders to gain an overview of the issues. Neither had population figures or fisher contacts, requiring interviews to be obtained through snowballing and cold-calling (e.g. approaching junk and kaito [water taxi/sampan] operators, restaurant owners and managers, fish farmers, fish hawkers, fish dryers). Most interviewees were older than 50 years, occasionally requiring prompts; interviews took place in familiar settings and during interviewee downtime. Discussions included previous and present types of fishing, territoriality and governance, government actions, fishing economics, present livelihoods, fishery ecology, environmental degradation, management and operations, customer interactions, socio-economic change, values and purpose, change in well-being. Interviews were recorded in Cantonese, translated and transcribed by an author fluent in Cantonese, then codified and analysed and questions prepared for subsequent interviews. Ninety-five semi-structured interviews were performed over 3 years, ranging from a few minutes to over 3 h, resulting in seventy high quality interviews (i.e. 200–7000 words with information significant to the investigation).

5. Findings

The findings describe how fishing generated values that enabled SK fishers to make successive adaptations and generate a diverse marine-based economy. Fifty-nine people with fishing backgrounds were interviewed, of these: 8 had been both fishers and fish farmers, 16 had been both fishers and junk charter operators and 9 had been fishers, fish farmers and junk operators. Six fishers had also become restaurateurs, 4 kaito operators, 5 fish-hawkers and 5 others work on private yachts, recreational fishing vessels and speedboats.

The evidence for values-based resilience rests substantively on interviews. In order to give the fishers voice quotes are employed for emphasis and initial fishing specialization and subsequent occupations of the interviewee are provided. The findings triangulate theory, interviews and secondary materials to cohesively depict the trajectory of resilience. The origins of the fishers' values were sought in earlier anthropological research [98,100] and the previous importance of the now diminished fish farming industry was verified with government statistics. Subsequent sections describe initiation of self-reliance and entrepreneurialism and successive adaptations. Each section relates distinct themes arising from the pressures and opportunities confronting the fishers. Connecting the sections is the overarching theme that adaptations are contingent expressions of self-reliance and

entrepreneurialism.

5.1. Fishing exacts self-reliance

“If anything, I wouldn’t call fishing freedom. It was very hard work. Take a look at the blisters on my hands. I needed to pull the nets in, it ain’t easy, and it sure ain’t freedom. We needed to work day and night, if we didn’t, we couldn’t sustain ourselves.” (purse seiner, trapper)

The self-reliance of SK’s fishers originated when they were forced off the land and onto a perpetual life on the water. They were referred to as waterborne people (Shui sheung yahn 水上人) and for hundreds of years derided by land dwellers as poor, illiterate and unskilled. [98,100] transformed that depiction in her account of the SK homeport of Kau Sai Chau before and after mechanization. She revealed that not only had the fishers developed sophisticated livelihoods, but had also embedded values that built a wellspring of resilience.

Fisher families functioned both as economic units and vehicles to generate and transmit values. A patriarch led a large nuclear family of 10 or more children. If offspring didn’t suffice, crews were reinforced with the wives and children of older sons, a few other relatives, or possibly hired crew. Crew size varied according to specialization, with purse seiners having 7–15 hands, longliners crewed by a nuclear family and perhaps one son’s family, and trappers smaller yet [100]. Living aboard minimised costs and brought families closer than in most fishing communities where gender and generational divisions of labor prevail [1]. An illiterate couple recalls:

“Onboard there were 10 or so of us—the entire family was involved. A child as young as 7–8 helped. That generation of kids wasn’t as precious as they are now. Those onboard must learn to do everything from observation. Since we started working at a young age, there was no opportunity to go to school. Kids helped to make/mend fish nets.” (purse seiner, long liner, construction, junks)

This nuclear structure contrasted with the kinship lineages typical of Chinese land dwellers, but allowed family size and bonds to co-evolve with changes to fishing operations. Post-war, purse-seiners and long liners prospered, the former catching small fish for salting, the latter pursuing the live fish trade. Smaller trappers and hand-liners struggled, and often the wife had to find additional land-based work. Most operators of today’s junk charters have a purse-seining background.

Although barely making ends meet, fishers possessed a profound competence, transmitted through intertwining human and social capital formation [32]. Masters were managers—of fishing expeditions, marketing, hiring and firing, maintenance, repair and replacement of boats and gear, negotiating loans, saving for repayment, and so on. They negotiated fish sales with middlemen wholesalers (*laans* 欄) daily, and formed long-term relationships, especially to borrow for new boats. Boats were built to order, usually by a family’s traditional supplier. Fishers also ran long accounts with the village store for fishing and everyday supplies. In 1945, the government established a fish marketing organization (FMO), open price system and cooperatives to provide loans [15,90] that transformed negotiating and managing skills. Apprenticeship reproduced the system, the eldest son expected to take over in his thirties. Younger sons earned a share from operations, sometimes operating a companion boat (purse-seining). Frequently, younger sons crewed for other families, finding positions through kinship, and potentially returning home or establishing their own operation. When a new spouse (usually a fisher) came aboard or a child matured, hired crew were released.

Kau Sai Chau fishers described themselves as belonging to “our bay”, expressed community through temple building, festivals and requisite money raising, and were tied to local market relationships [100]. However, families operated independently of one another and weak community and self-governance deepened the self-reliance born

of family-based fishing. The homeports even lacked leaders, except when chosen to manage temple festivals. The categorical basis of co-existence was mutual respect for each family’s right to fish where they pleased, a pattern of co-existence van Ginkel [96] termed cooperating individualists. Ward [98] noted this disposition, and it is still evoked by informants:

“Fishermen did not set boundaries for themselves. They went wherever they pleased. If you see too many boats in one area, and would like to go to another, it’s entirely up to you; and by the same token, if you would want to stay you could. Each did their own thing.” (purse-seiner)

In interviews elderly fishers insisted that fishers had the right to fish freely, whether locally, into Chinese waters or beyond. They expected these rights for themselves and others. Thus, notable features of this population were weak social capital and reliance on family independence. Some of this was related to the over 20 fishing specializations that differentiated fishing grounds and reduced conflict: “Each boat and family fishes in a different place. This matches their methods of fishing” (purse seiner, junks, fisher association president). Although, many fishers fondly recall past freedoms, others, who later initiated fisher and junk associations, also regretted the lack of mutual assistance, especially, a lack of a unified voice to engage the government.

5.2. First adaptation: mechanization and metropolitan integration

From the mid-1950s the seemingly simple managerial capacities of the fishers transformed into sophisticated entrepreneurialism as the fishers integrated their livelihoods into the metropolitan economy. Mechanization prompted greater financial and intellectual investments and led to changes in fishing and household operations. When engines became accessible, the government instigated loans and educated fishers and boat builders for adaption to local vessels and practices. A winnowing occurred as more successful fishers invested in mechanization. Masters often delegated obtaining a licence to literate children. Engines hastened operations, improved catches and multiplied incomes, while allowing escape from weather, speed to market and leisure time [90,100].

“We used to paddle about and used our hands to pull the nets in, then after motorisation things began to lighten up. We could go out further, and collect more fish, and had more time. We used to leave at 4 a.m., and arrive at 6 a.m., now we can get out at 5 a.m. and arrive the same time...” (gillnetter, trapper).

SK’s small market had forced fishers to restrain catches or to dry fish (and lower value), but mechanization and ice enabled fishers to sell more and obtain better terms in other markets. Pair purse-seiners switched to single boat operations, removing extended family and hired crew, thereby reinforcing the nuclear family production unit. Engines requisitioned on-board sleeping and storage space and increased male dominance, often female and elderly relatives moved ashore to work.

Mechanization helped some fishers become better off than SK land dwellers. A proportion became relatively wealthy and bought houses [15], but the pressure to increase income produced mixed consequences. While several informants recall how catches increased greatly, they complained that the small species caught (rabbit fish, noodle fish, squid, sunbeam by purse seiners) resulted in low returns. Consequently, many SK fishers ventured to the China coast, the South China Sea, and even the Indian Ocean. They bartered in Mao’s China and traded with Japanese and Taiwanese firms in the Indian Ocean. The pressure to increase catches led to methods destructive to the ecology and fishers. One interviewee lost an arm to dynamite and another salvaged his brother. In retrospect, the fishers realize the consequences of insecticide use, trawling (on sea grass and young fish) and other practices:



Fig. 3. Sai Kung mariculture rafts, derelict and converted for recreational use.

“Another factor is nylon nets. Before we only had one kind. Now there are triple layered nets on the market with different sized apertures. There is no chance for the fish to escape. In addition to this, nowadays fishers no longer need to take the nets out of the water, to clean, or repair. This practice of continually leaving the nets in situ may seem “cunning,” but it leaves little chance for the fish to swim about, and/or reproduce.” (purse seiner, traps, fisher farmer, factory, junks).

Further evolution came with government and cooperative schools that removed children from the crew in a welcomed way [3].

...the AFCD (Agriculture, Fisheries and Conservation Department) were very helpful, I praise them. They erected a fishermen's village for us, and help us send our kids to school. A Catholic priest also raised funds so our kids could go to school (purse seiner, longliner, fish farmer)

Most informants went to schools established in larger anchorages, but attendance fluctuated with daily and seasonal needs of fishing and they received only the equivalent of 1–3 years of education. This minimal education was sufficient to join a burgeoning economy, typically in construction and longshoring, supplementing fishing incomes or allowing escape from fishing's dangers and discomforts. These alternatives became increasingly important as mechanization soon brought diminishing returns and a depleted fishery, as cheaper fish were imported to the markets, and as the metropolitan economy engulfed the fishery.

5.3. Second adaptation: mariculture

The decline of the inshore fishery became pronounced through the 1970s and most SK fishers turned to mariculture. This endeavour increased yearly incomes to a comfortable US \$13,000–26,000. Most waterborne folks could now buy a home on land and send children to school fulltime. A HK survey in 1982 found 1789 mariculturalists operating 1745 rafts in 50 locations, totalling 25 ha. Production grew from 720 metric tonnes in 1979 to just over 3000 in 1988–89 [60]. Largely retreating from offshore fishing, SK fishers developed the most productive mariculture, increasing from 407 t in 1979–1000 in 1987–89. Initially, the government considered mariculture to be “marine squatting” and disputes over raft sites even drew in organized crime ([60]), but eventually zoning and fees for non-transferable rights were established.

Fishers earned their increase in income. They learned (discovered) how to breed and raise fish and how to obtain and deal with greater levels of fixed and variable capital. They needed to respond to production risks such as typhoons, toxins, algae blooms and pollution, and

market risks such as increased costs for feed and fry, cheaper imports and large-scale competitors. The local industry prospered for two decades until costs and competition, and waning interest from educated children reduced the viability and purpose of the ventures. Informants reflected on their farming experience:

“Most tanks have only one type, such as grouper or sunbream. But some are mixed up, and why? Because some fish, such as garoupa, remain motionless after they are fed, but sunbream keeps on moving around. It is important to have fish that disrupts the stillness of the water.” (purse seiner, fish farmer)

“What I learned from fish farming was that after a while it pollutes the waterbed. Each day you feed the fish, and the residual feed, which is not consumed, deposits on the seabed and produces toxins. The AFCD used to remove the sediments by scraping the seabed, yet they did this for a short while only ...” (gillnetter, printer, fish farmer, junk charters)

“The larger companies can hire Mainland workers. HK workers are too expensive; one cannot afford to pay HK\$ 10,000 as salary, while the mainland workers are willing to work for HK\$ 3000 or so. Yet, if you don't pay somebody at least HK\$ 10,000 in HK you won't find anybody for the job.” (purse seiner, long liner, fish farmer)

From 3000 t in 1997 and value of US \$22 billion with 1526 operators, HK production fell to 1000 t in 2013–14 and US \$13 billion value with just under 1000 operators. The remaining SK family operations are interspersed among derelict rafts and rafts converted to recreational use such as sport fishing, barbecuing and gambling (Fig. 3). Important mariculture legacies are the fiberglass skiffs the government designated for access to the farms (Fig. 4). The skiffs are manufactured locally, with higher-powered versions used for recreational fishing, taxis and smuggling. Most importantly, these skiffs allowed fish farmers, junk operators and others to remain as gillnetters, longliners and trappers on a low cost seasonal or part-time basis.

5.4. Third adaptation: service industry

As SK's fishers integrated into the metropolitan economy, urbanites were drawn to SK for beaches, hiking and restaurants. Fishers, being “opportunity grabbers” (gillnetter, printing, fish farming, junks) transformed themselves from primary to service industry providers. Junks were redesigned for charters; marine expertise transferred: captains and crew for private yachts; *kaito* and water skiing businesses; fish farms converted for recreational fishing, barbeques, karaoke and mah-jong. On land, fishers became seafood restaurateurs and employees. How the fishers blended marine expertise with the soft skills necessary for services is revealed through the junk charter and restaurant businesses.

Junk charters began surreptitiously in the 1970s because it was



Fig. 4. Fisher-people using a fiberglass skiff for gillnetting; private yachts employing fishers as captains and boatboys in background.



Fig. 5. Sai Kung Charter Junks during the summer.

illegal to carry passengers on fishing boats. Soon, the decks were transformed into floating party platforms carrying 20–40 people on day-trips to the beaches and offering wake boarding and banana boating (Fig. 5). In the transformation, crews scaled back to a married couple. The husband, as captain, draws on seamanship and knowledge of local waters and performs maintenance and repairs. The wife caters to guests, occasionally cooking meals. Their day includes cleaning and preparing the boat, collecting customers at the wharf, eight hours at sea, cleaning up and occasional night-time fishing trips. Couples developed people skills, Mandarin and English proficiency, marketing and internet abilities, and learned to guide through the UNESCO Geopark. Perhaps most importantly, they shifted mindsets from an occupation free of behavioural expectations to the discipline of customer demands:

“In the services industry, it is most important you treat people well, such as, have good manners; that’s how you get referrals. Unless you have good manners and attitude, it will be hard to get customers. Once you know how to get along well with others, then it’s ok. You need to talk things over, be courteous. The most important thing is having a good attitude, like waiters.” (gillnetter, printing, fish farming, junks)

When necessary, family assist or friends are hired, the latter reducing profit. Financing still depends on family or moneylenders and awareness that reputation requires dependable repayment. In the seven off-season months, couples maintain the boat, fish, fish farm or engage in other occupations.

Business acumen has expanded, for example, after borrowing to buy one junk, an illiterate couple grew their business to four boats, hiring crew and advertising on the internet. Revenue varies from US \$38,000 to \$77,000 a year, and despite the five-month season, junks provide a better livelihood than other jobs available, including fishing. Interviewees recounted overseas travels and home ownership unimaginable to previous generations. Competition, however, is fierce and management requires sophistication.

“According to the Marine Department regulations, 3 personnel are required, but most operate with two people saving \$500 for one person’s labor (and salary). You may in fact take that \$500 off your ‘profits’ in order to win the bid for jobs (as customers do shop around!). So, do the maths, if you are treating it as a business, it ain’t money making, but still it is better than being unemployed. In other words, you are sacrificing the depreciation and wear and tear costs of your boat to get the job.” (gillnetter, construction, junks)

The junk business has called forth collective action stronger than fishing. Authorities had looked away from the illegal charters if booked through travel agencies. A union was formed to gain the legality that would remove agency cost and allow further development of the

industry. Junk owners were formally allowed to carry passengers in 2007 after agreeing to safety and maintenance regulations. The increased costs arising from those regulations, however, divided opinion and the union. Since, the two unions have worked to achieve collective goals for the junk operators: establishing informal procedures and enlisting support from the marine police to reduce conflict for wharf space; petition for an additional wharf; dredge along the wharf; recognition of the Geopark; assistance for semi-literate fishers with insurance; advise on dealing with drug abuse by passengers; guidance on safety, environment and maintenance; and sponsoring annual banquets with participation of government representatives.

As in co-management of fisheries [48], leadership was critical to organization of the junk operators. The initiator of the original union, a yacht broker, remains its torchbearer and a crucial node in the community network. He claimed that 50% of those working on private yachts as captains or crew are from fisher-backgrounds and he secured these jobs through his brokerage connections. These people are a younger generation than junk owners because yacht owners look for youth. However, similar to the apprenticeship and social reproduction of younger fishing family sons, many fishers who worked on private yachts later buy and operate a junk. The union leader takes a long-term, complex view of his community; making connections through life stages, seasons and occupational opportunities, family composition and education and the competitive advantage provided by the marine heritage.

“I have three children, but not necessarily all of them will perform well at school and sending them overseas for study is not easy on the family. A household needs to pay in excess of US \$130,000 for a degree. If they only finished Form 5, however, it is hard to find work in HK. You cannot terminate a young person’s future like that. Rather than there being nobody in the industry, today we can see a lot of young people starting-out. Some elders, who are no longer around, told us that “there is no future” but I disagreed and I told them there was: this world is surprisingly full of possibilities! If fisher-people cannot find work, you will think back and evaluate yourself; you are a fishermen, you are a waterborne-person, and you know the water well. You will try it once you realize that there is lots of competition working on land. Instead of thinking about the short-term viability, we need to think about the future, the future of our kids.” (purse seiner, construction, junks, yacht broker).

Sai Kung is most famous for seafood and especially for the enormous tanks from which customers select remnants of the oceans’ bounty (Fig. 6). These restaurants sprouted from humble fish stalls and now line the seaside promenade. It is a substantial industry cluster, with four restaurants serving in excess of 200 people and employing 60–200, and another 10 smaller, family-run operations. Most restaurants are owned



Fig. 6. Fish tanks outside a Sai Kung Restaurant.

by fishing families and the fishing port ambiance suggests local production, however, some 90% of the seafood is imported. Once locally caught groupers, croakers and shrimp are imported from Southeast Asia, along with a great diversity of fish from around the world. Even some varieties of fish sold from skiffs along the waterfront are imports. All these fish are sold at prices that reflect world markets and thin margins on the meals reflect intense competition and lack of differentiation among restaurants. All restaurants purchase from the same markets and at market prices despite long-standing relationships.

Ironically, that the SK restaurants sell little in the way of local fish further attests to the fishers adjusting to the demands of the service economy. Managers insist that price is the overwhelming consideration for customers and restaurateurs. There is no notable demand for local fish or cooking methods, and attempts to raise value by branding local fish met with indifference: “We have tried to develop a brand name. It has been advertised in magazines, but we only got one phone call afterwards. That's it. The market is very small” (restaurant manager). A cognoscenti order SK's crabs, rabbit fish, prawns and squid for freshness and unique taste, but most customers consider them too small or bony. Some local captured and farmed fish is bought for high quality, for stability in price and supply, and to counterbalance the price pressure arising from Chinese demand for imported fish. Still the restaurants focus on market preferences: the Cantonese desire for steaming and light marination; ignoring the waste when some mainland customers over-order expensive fish to show face to guests; acquiescing to Westerners who insist on deep frying; and providing cost-conscious clientele with low-cost Chinese mariculture products. While some managers recognized the need for sustainable fisheries, they said customers do not.

Despite the lack of demand for local fish, fishery and restaurants are strongly connected through entrepreneurialism and employment. The fisher-owners look out for local fishers in fairness of payment and accommodate fishers' respect for weather and hazardous conditions. Some fishers work as service staff, but a few dozen fishers manage the fish tanks and handle sales because of their knowledge and experience in handling live fish. That profession exposes a key linkage between the fishery and the restaurants:

“...there are fewer fishermen remaining, this will make it even harder to find suitable workers to look after our fish tanks. Somebody needs to be watching our seafood 365 days a year; it is non-stop work. It is technical and specialised knowledge.” (fisher's son, restaurateur).

At restaurants owned by non-fishers, fewer ex-fishers are employed, but they still buy local fish in similar proportions and one even operates a fish farm and sells excess to competitors.

6. Discussion: policy paradox and potential

6.1. A value basis for metropolitan fishery resilience

On the premises that a sustainable fishery requires a resilient fisher population and that resilience in a metropolitan fishery can offer insights into fishery management in general, this research sought to explain the resilience of the fisher population in SK. Although SK fishers have proven resilient to environmental change, their path to resilience does not accord with approaches to resilience portrayed in meta-studies of CM-SESs [45]; [48]) or as exemplified in studies of community-based fisheries in Japan [64], Canada's Scotia-Fundy region (Wiber et al., 2004) and Mexico's Pacific coast cooperatives (McCay et al., 2013). Initial investigations revealed that SK shares more in common with fisheries that resist co-management, such as Taiwan's Penghu archipelago ([104]) and the Roderigues Islands [19]. More importantly, the premise that sustaining the ecology of fisheries is the means to secure resilience and livelihoods does not fit with the challenges of the SK fishers' metropolitan situation.

SK fishers until recently were poor and lived at a socio-economic level deserving of a developmental livelihood approach to fishery resilience [9]; Ferrol-Shulte et al., 2013; [36]. Many remain at a very low formal education level. As Hong Kong rapidly developed, the fishers faced escalating costs of living and land values and an education system and economy that absorbed fishers and the community's young generation. These fishers faced gentrification pressures exceeding that which rural fishers are experiencing with the influx of tourists into their communities [33,92]. The fishers adapted to these challenges by progressively integrating their marine-based livelihoods into the metropolitan economy. A few of the diversification and alternative occupation strategies of the SK fishers, such as tourist charters and restaurant operations have been examined in other situations [20,23,24,68,78,81,99], although the expansiveness and success of the SK activities is of note. The fish farm, kaitos, private yacht, construction, and longshore options are likely particular to SK.

More important than identifying the diversification and alternative occupation options or even their particular entry pathways and requirements, however, is revealing the impetus for adaptation and the capacity that enabled the fishers to constantly interweave their strategies and make successive adaptations. The SK fishers' adaptations are rooted in the slow-moving variables of self-reliance and entrepreneurialism. These values were exacted by fishing yet, are not necessarily expressed through fishing; rather a constant willingness to identify and exploit an economic niche.

Fishers articulated these values several times, for example:

“Fishermen do not like to rely on others or the government; they only like doing things themselves. So, if fishing cannot sustain a living they will not apply for welfare. In the past, fishers only fished, but now they also operate cruise vessels and open seafood restaurants. There isn't anything we can't do. Perhaps we cannot fly into space, but in terms of making a living, we will always find a way!” (purse seiner, fish farmer, junks)

Less anecdotally, the evidence for these values lies in the fact that almost all informants made occupational shifts that extended fishing livelihoods into transformed but still marine-based professions. These values are more deeply rooted than valuing fishing as source of identity and culture—even though fishers' still referred to themselves, family and community as fishers. This perspective on values differs from recent livelihood and well-being research examining fisher identity formation, relational place-making and that depicts fishing traditions as the basis of continuity ([12,62,95]). Yet, the approach supports the view that values are a strong determinant of behaviour [14,42,56,76]. Insofar as identity is ephemeral with people assuming multiple identities at one time and overtime and that values are a much stronger predictor of behaviour [51], it is important to determine what the underlying values are in order to recognize and visualize the possibilities and limitations to resilience.

6.2. A resilience paradox

Values as slow-moving variables present a paradox for sustainable fishery policy. The fishing community continues to exist. Although most fishers are older they continue to pass on marine livelihoods to the next generation, albeit with fewer taking up the businesses. Moreover, fishers have progressed from a derided people scrapping out a precarious livelihood to a relatively prosperous cohort of small business-people in an advanced metropolitan economy. They enjoy living standards much higher than their grandparents, parents or in their youth and do not depend on fishing with its danger and toil. Moreover, their services—junk charters especially—provide HK with valued recreational ecosystem services. However, it is evident that the population's resilience and the transposition of self-reliance capacities do not necessarily lead to a sustainable fishery. The alternative livelihoods draw people out of fishing, and while ecological pressure is reduced, so are

incentives to build a sustainable fishery.

The paradox of SK's resilience path is akin to a gilded social trap, a new but short-lived success within the CM-SES that may lead to a collapse. The social trap concept was extended from poor fishers compelled to overfish to the wealthy Maine lobster fishery because the latter imposes a monoculture that threatens ecosystem and fisher community with future collapse [26,58,85]. SK fishers may not be imposing a monoculture, but without maintaining a fishing foundation, the new ancillary industries may be short lived. Eroding the foundation of fisher culture—the transmission of maritime skills and intimate knowledge of the fish and of the area—presents dangers for not only the fishery and fishers, but for other services and human capital that HK depends on.

Community opinion on the future of fishing is divided. The District Council Chairperson, born a fisher and co-owner of the restaurant that attempted branding local fish, dismisses fishing and sees tourism as the future. Other elderly fishers expressed similar opinions. The founder of the Charter Junk Association is more optimistic. He insisted that marine-based livelihoods are integral to the well-being of young and old and believes they possess considerable assets. Junk owners, for example, hold a competitive advantage over large companies because they can match the five-month junk season with fishing, while younger people can find secure employment and experience until they return to marine entrepreneurialism. Moreover, fishers have distinct advantages over land dwellers in operating marine businesses: they know the fish, the underwater landscape, can deal with the conditions, can drive the boats, and are mentally and physically tough.

6.3. Policy potentials

The groundwork has been laid for policy interventions to support a sustainable fishery. Purse seiner fishers recognize the damage caused by their past use of dynamite and pesticides, gill netters of the unsparing efficiency of triple layer nets, and trawlers have been eliminated. Fishers are more accepting of sustainable fishing requirements and controls, indeed many consider the HK government negligent in comparison to China's seasonal moratorium. Even as junk operators, they are concerned about the environmental impact of their customers. More concretely the fishing fleet has downsized to skiffs useful for long lining, trapping, controlled gill netting and other more sustainable methods. While the fishing association is quiescent, the robust junk association provides the social capital and network on which to introduce participatory and control methodologies from the co-management playbook.

Prospering in an advanced metropolitan economy, on a sustainable fishery foundation, requires flexibility. This research suggests that interventions be guided by respect for the fishers' values combined with mechanisms to strengthen lifestage, seasonal and part-time livelihood connections. The fishers' willingness to run their own businesses, pursue alternate occupations, and work for others when necessary give them a competitive advantage when fishing and leisure services are seasonal and demand varies through the week (e.g. restaurant businesses). Present policies inhibit flexibility, for example, a boat registration system that makes exit and entry into the industry expensive (see [103] for similar example). This system not only inhibits flexibility through life stages, but also generational succession. Similarly, the burdens on fisher occupational flexibility are amplified by the increasing licencing and permit fees required for their various businesses and occupations. In accord with co-management's precept of participation, devising policies to support flexibility require the government to listen to the fishers:

"It is no use sending junior staff here each time, and after we say something they respond by saying, 'I'll let my superiors know,' but I am never sure if the message gets across." (long liner, fish hawker)

"The government cannot suddenly forbid people from fishing

around the island. That's absurd. For 100 years fishermen have been in this area, and fishing has been their way of making a living, and how dare you ask them not to!" (purse seiner, junk charter, fisher association head)

Policy also needs to address socio-economic and sustainability issues beyond fishery management. The fishers are well aware that HK is a freeport and laissez-faire competition is the foundation of governance. That awareness was imposed by the damage that low-cost imports wreaked on local capture and mariculture. Yet, fishers see this freedom to import unsustainably caught fish as a barrier to developing sustainable fishing in HK. They see themselves as asked to bear the costs for environmental stewardship, while others are rewarded for bad behaviour and HK consumers escape responsibility. Moreover, they see a blatant bias in policy:

"Our capital is raised by us, the government did not help us. Fishers relied on themselves. Now cars, environmentally sustainable cars, get subsidies, the boats we use however do not. There's no such thing." (purse seiner, junks, fisher association representative).

Indeed, HK gave wealthy buyers of over 10,000 EVs exemption from a first registration tax worth about US \$65,000 a car—a total subsidy of US \$650 million. Each subsidy was many times the yearly income of a fisher and 2–3 times the income of a junk operator. Never has the fishery received such funding to make practices sustainable. Ironically, about 400 inshore trawler owners received close to US \$200 million to surrender their boats and in lieu of 11 years income. Indeed most efforts to make the fishery sustainable encouraged abandoning fishing for alternative livelihoods [89,105]. If society and policy-makers can consider the fishers' dilemma in comparison to other environmental concerns, then perhaps they can generate more complex and effective policies. Given the benefits of the ecosystem and socio-economic services provided by the fishers, they seem deserving of comparable treatment, especially if they can provide a profound example of sustainable development.

7. Conclusion: implications

What lessons can be drawn from the experience of these metropolitan fishers for other fisheries? SK fishers have proven that marine-based livelihoods can prosper in advanced metropolitan economies by generating business niches, a success that is underpinned by the slow-moving variables of self-reliance and entrepreneurialism. The values have been key to developing resilience pathways distinct from fishing-based adaptation strategies such as changing catch portfolios and locations [31] or relying on co-management to bring exploitation under control [45,48]. The values also help to explain why these fishers have succeeded in diversification and alternative occupation strategies, especially their successive profession shifts [8,20,23,24,40,68]. Ironically, the complexity of metropolitan economies, which have for the most part forsaken their fisheries, offer fishers more opportunities to initiate economic niches than non-metropolitan fisheries. The typical CM-SES of the periphery does not offer broad and deep niche opportunities [17,54,80]. However, the capacity of fishing to generate entrepreneurial values, and that the expression of these values is not limited to fishing but transferable to other ventures is still likely a valid precept for assessing fishery resilience in other contexts and for proposing supporting policies.

The SK fishery is also a reminder of the aetiology of the dilemma facing the CM-SESs of the periphery. Cities like Hong Kong largely sacrificed their inshore fisheries. Then their demand for seafood compelled distant inshore fisheries to compete against each other and with industrial fleets, pushing down fish value and ramping up catch volumes. If Hong Kong can capitalize on its remaining inshore community to build a sustainable fishery then the rewards may be more than a marginal reduction in pressure on distant ecosystems. A greater benefit

would arise from deploying the deep financial, human and regulatory resources of cities to advance beyond fishery management to create cross-sectoral policies that recognize the city's responsibilities to ecosystems within and beyond its borders. The crucial policy dilemma is that localized fishing (sustainable or not) must compete with unsustainable global exploitation. In the face of that predicament, the SK fishers found a work-around by developing several new ventures that maintained their marine livelihoods. While they still maintain significant linkages with fishing they present HK with an opportunity to become a laboratory to devise policies to build a sustainable metropolitan fishery. Hong Kong could set an example of metropolitan responsibility and credibility and stimulate the diffusion of sustainable practices throughout the global industry.

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