



SFP Sustainability Overview of Wild Fisheries that Supply Shrimp

December 2013

Executive Summary

This briefing represents the first edition of the Sustainable Fisheries Partnership (SFP) sustainability overview of fisheries that target and supply shrimp. This overview is based on information from FishSource.com, SFP's online information resource about the status of fish stocks and fisheries. The shrimp fishery coverage in FishSource is not yet comprehensive, as it is primarily driven by information requests from SFP's buyer partners.

Ratings for five scoring criteria from FishSource were used to group fisheries into the following three categories:

- Category A – Fisheries that score 8 or above across all FishSource criteria
- Category B – Fisheries that score 6 or above across all FishSource criteria
- Category C – Fisheries where at least one criterion is scored below 6

FishSource profiles, including data used in generating ratings, are generally updated annually with the most recent publicly available information drawn from scientific stock assessments, MSC assessments and audits, and scientific literature. The ratings are based on current status at a certain point in time (often more than a year in the past), which is not necessarily the year in which the raw material is being harvested or processed further into the supply chain. Consequently, the analysis presented in this briefing should not be used as a practical, 'real-time' purchasing guide, but rather as a source of information describing status at the most recent point in time that public disclosure of information and time needed for updating FishSource and conducting data analysis allows.

The shrimp sector is characterized by variety, e.g., industrial and artisanal fisheries, developed and developing nations, warm-water and cold-water species, coastal and deepwater fisheries, and data-rich and data-poor management systems. This variety complicates the effort to define and assess sustainability in a quantitative and efficient way for a sufficient number of shrimp fisheries to account for the majority of global volume. In light of the complexity of the shrimp sector and shrimp's status as the world's most highly valued fisheries commodity, SFP has prioritized this sector for further research in 2014 and beyond, including formation of a working group of experts, development of a species-specific sustainability evaluation method, and more intensive data gathering. This report reflects SFP's present knowledge and the status of shrimp fishery profiles on FishSource. Subsequent shrimp sector reports will contain improved detail and specificity, provided that continued support for this work is secured.

In addition to categorization of fisheries, the analysis described in this paper also includes data regarding recent catches, harvest and biomass trends, gear types, fishery improvement

project (FIP) engagement, fishery improvement needs, Marine Stewardship Council (MSC) certification, and outstanding MSC conditions (for certified fisheries). Results are presented by fishery and also grouped into warm-water and cold-water categories. A third category of “paste shrimps” (consisting mostly of species in the *Acetes* genus used in production of condiments) is also described, although no profiles of fisheries in this category have yet been developed in FishSource.

On the basis of the accompanying information located in the Annex, we conclude that:

- Shrimp fishery profiles in the FishSource database currently account for 37% of global shrimp harvest, including 42% of warm-water shrimp fisheries and 61% of cold-water shrimp fisheries. There is currently no coverage of paste shrimp fisheries, which comprise 20% of global shrimp harvest. Profiles covering data-deficient fisheries represent 13% of global shrimp harvest; if they are removed from consideration, FishSource accounts for 24% of global shrimp harvest.
- Among warm-water shrimp fisheries profiled in FishSource, which account for 42% of the total global harvest volume of warm-water shrimp, 0.9% of the total catch volume comes from fisheries in very good condition (Category A), 8.8% comes from fisheries that are in good condition but would benefit from improvements (Category B), 42% originates with fisheries in need of significant improvements (Category C), and 48.3% is harvested by fisheries that could not be scored due to data deficiency.
- Among cold-water shrimp fisheries profiled in FishSource, which account for 61% of the total global harvest volume of cold-water shrimp, 12% of the total catch volume comes from Category A fisheries, 73% originates with Category B fisheries, and 15% is harvested by Category C fisheries.
- Among the 20 warm-water fisheries that were rated as Category C, issues with illegal, unreported, and unregulated (IUU) harvest contributed to the fishery’s classification in 90% of cases. 80% of the Category C fisheries also received low marks due to managers’ inability to translate best available science into management measures.
- Developing countries account for 89% of Category C warm-water shrimp harvest. Meanwhile, American and Australian fisheries comprise 79% of warm-water Category A and B volume.
- Among the nine cold-water fisheries that were rated as Category C, the absence of quantitative harvest control rules resulted in or contributed to the fishery’s Category C classification in six (67%) of the cases.
- Fisheries conducted by European Union Member States account for the majority (75%) of Category C cold-water shrimp fisheries. Meanwhile, Category A cold-water shrimp fisheries are all managed by Canada..
- Cold-water fisheries engaged in the Marine Stewardship Council (MSC) program account for the majority (67%) of the total, global, cold-water shrimp harvest volume (59% is certified, 8% is currently in MSC full assessment). No cold-water fisheries are engaged in credible, verifiable fishery improvement projects (FIPs) at this time.
- Warm-water fisheries certified by MSC account for only 1% of the warm-water shrimp global harvest volume. There are no warm-water shrimp fisheries currently in the MSC full-assessment phase. Fisheries engaged in credible, verifiable FIPs account for an additional 7% of warm-water global harvest. Global paste shrimp fisheries are neither engaged in the MSC process nor in any FIPs at this time.

- Of 90 conditions assigned to shrimp fisheries as a part of 12 MSC shrimp fishery assessments, 17 have been resolved, 68 are open and on schedule to be completed in the requisite time frame (per Certification Bodies' assessments of progress in annual audit documentation), and 5 are behind schedule.

Summary of fishery improvement priorities for the shrimp sector

Among all region-specific improvement recommendations provided in this document, the following are considered to be priorities for warm-water shrimp fisheries:

- Fishing gear selectivity must be evaluated to determine if improved size-selective or low-bycatch fishing gear needs to be introduced into the fishery.
- An ecosystem management approach should be adopted using assessments of fishery impacts on the target species and each bycatch species.
- Regulators should consider the adoption of closed areas and spatial management approaches to better ensure robust stock status.
- Compliance with fishery regulations can be improved through use of Vessel Monitoring Systems, implementation of at-sea monitoring programs, and organization of third-party gear inspections. Severe fines for violations should be put into place and enforced.
- Data transparency and deficiency issues can be addressed through the gathering and publication of species-specific catch and effort data, indices of recruitment success, research plans including quantitative harvest control rules, and compliance and enforcement information (e.g., the number of area and gear violations).

The following improvement is considered a priority for cold-water shrimp fisheries:

- Quantitative and precautionary harvest control rules should be put into place.

For both cold- and warm-water fisheries, the following recommendation is relevant:

- Bottom trawling impacts upon benthic habitats must be adequately assessed.

Retailers and suppliers of shrimp are called upon to participate in existing FIPs, as well as initiate FIPs in fisheries from which they source product that are neither engaged in the MSC process nor in a FIP.

Introduction: What is the SFP Shrimp Sector?

SFP is applying a sectorial approach to its mission of putting actionable information in the hands of retailers and the supply chain in order to leverage market forces to achieve fisheries sustainability improvement. Seafood sectors are defined in terms of shared biological characteristics of harvested species and are designed to facilitate standardized approaches to data gathering and analysis. They are also intended to group fisheries that are of interest to members of the supply chain.

With respect to shrimp, all species grouped as “shrimps and prawns” by the International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) of the Food and Agriculture Organization (FAO) are included in the SFP shrimp sector. This grouping includes a diversity of species (approximately 3,000), although only 300 are of commercial

significance, and about 100 account for the vast majority of the world's commercial harvest.¹ These species are accounted for in the FAO's FishStat J database (including shrimp harvests in 2010–2011 for 104 countries and 70 “species items”), which most often refers to species, but sometimes to a genus, family, or suborder that could contain multiple nested species. The average annual, global, wild-capture shrimp harvest for 2010 and 2011 amounted to 3.2 million metric tons (Gillett 2008; FishStat J 2013).

The SFP shrimp sector is further divided into the following three groups: 1) warm-water shrimp (the Penaeoidea group, including the genus *Penaeus*²); 2) cold-water shrimp (the Caridea group, including the genus *Pandalus*); and 3) paste shrimp (the Sergestoidea group, including the genus *Acetes*—the name “paste” refers to its primary use on the market in preparation of condiments popular in Asia). These three groupings have been used by the FAO in its work on shrimp fisheries, and are convenient both in terms of their biological basis and the fact that different members of the supply chain tend to have particular interest in one of these three groups. Warm-water shrimp harvest accounts for 63% of wild-capture catch volume, followed by paste shrimp (20%) and cold-water shrimp (17%) (Table 1).

Table 1: The three sub-sectors within the SFP wild shrimp sector and their portions of global wild-capture shrimp harvest (FishStat J 2013).

Sub-Sector	Annual Harvest (Avg, 2010–2011, '000s of MTs)	Percent of Global Shrimp Harvest	Top Three Countries for Harvest Volume
warm-water shrimp	2,035	63.5%	1. China 2. India 3. Indonesia
paste shrimp	633	19.8%	1. China 2. Malaysia 3. South Korea
cold-water shrimp	536	16.7%	1. Canada 2. Greenland 3. Argentina

Assessment Criteria

We have analyzed scores resulting from an evaluation of 66 stock-scale (high-level, including all gears and sources of product) and fishery-scale (lower-level, focusing on particular sources, gears, or a combination of them, nested to the respective stock) profiles when assessed against five FishSource criteria regarding management quality and status of the target stock. The five FishSource criteria are:

- Score 1 – Is management precautionary?
- Score 2 – Do fishery managers follow scientific advice?
- Score 3 – Do fishers comply?
- Score 4 – Is the stock healthy?
- Score 5 – Will the stock be healthy in the future?

The criteria are scored on a scale of 0 to 10, with 0 being the lowest and 10 the highest score possible. For many of the shrimp fisheries included in the analysis, qualitative scores were attributed either because information needed for calculating quantitative scores was unavailable or because the fishery is not managed using the parameters that are input into FishSource to generate quantitative scores.³ Preserving comparability with quantitative scores, qualitative scores are obtained by using cut-off points derived from the Marine Stewardship Council fishery assessment method: “< 6” → high-risk condition, indicating a

¹ The ISSCAAP “shrimps and prawns” grouping excludes certain species and assemblages that are often lumped with shrimp and prawns elsewhere: for example, Nephrops, crayfish, and krill. These species are consequently not included in the SFP shrimp sector.

² Taxonomic authorities in the Americas generally divide the genus *Penaeus* into two genera: *Litopenaeus* and *Farfantepenaeus*.

³ Find out more about the FishSource methodology in the FishSource [FAQ section](#).

negative assessment finding when assessed against that criterion; “≥ 6” → medium-risk condition, indicating that improvements are required for that criterion; and “≥ 8” → low-risk condition, indicating that the fishery meets the criterion conditions.

Due to the biological specificity and complexity found in the shrimp sector, as well as the high value of shrimp on the market, the SFP Science, Research, and Data Division is currently working on the development of a species group-specific sustainability evaluation method to be used exclusively in scoring of shrimp fishery profiles. This process is currently in the phase of outreach to experts and data gathering. This work should result in improved information availability and analysis in the 2014 shrimp sustainability overview report.

FishSource scores are used to place fisheries into one of three ranked categories (A, B, and C). The categorizations are based on the quality of management (scores 1 to 3) and status of the target stock (scores 4 and 5). While information on environmental impacts of fishing activities is also captured in FishSource fishery profiles, it is not currently used in the categorizations—an exclusion that SFP considers a weakness in the evaluation method and intends to address in the future. Categories A, B, and C are defined as follows:

- A – Very well managed fisheries that score 8 and above across all FishSource scores
- B – Well managed fisheries that score 6 and above across all FishSource scores
- C – Poorly managed fisheries where at least one FishSource score is below 6

A fourth categorization, “Data Deficient,” is applied when no scores for any of the five criteria can be attributed to a fishery due to lack of publicly available information.

In addition to categorization of fisheries, the analysis described in this paper also includes data regarding recent catches, harvest and biomass trends, market trends, gear types, fishery improvement project (FIP) engagement, fishery improvement needs, Marine Stewardship Council (MSC) certification, and outstanding MSC conditions (for certified fisheries).

Results

Results of our sustainability analysis of the wild-capture shrimp sector are described below, with supporting information located in the Annex and in the appendices. Conclusions of particular importance include:

- Global wild-capture harvest of shrimp peaked in 2003, and has since exhibited a declining trend, while shrimp aquaculture has trended upward over the last decade and has exceeded wild production since 2007.
- A greater proportion of warm-water shrimp fisheries are facing pressing sustainability needs in comparison with cold-water shrimp fisheries.
- Official engagement in improvement efforts is not as common in the shrimp sector as in other seafood sectors.

Emerging Market Trends

As of 2011, global production from shrimp farming has overtaken wild-capture harvest, accounting for 55% of global harvest volume in that year (FAO 2012) (Figure 1). This change in balance in favor of aquaculture has occurred quite rapidly, with successful shrimp aquaculture ventures only beginning to make significant contributions to global markets in the 1980s. As of 2005, wild-capture fisheries still accounted for the majority (60%) of shrimp global harvest. However, in the five subsequent years, aquaculture made significant advances, with Southeast Asian nations (Thailand, China, and Vietnam) leading the way. Global, wild-capture shrimp production, meanwhile, achieved a peak in 2003, followed by a declining trend through 2010 (Figure 2). A rebound upward occurred in 2011, but not sufficient to counter the overall downward regression slope from 2003 onward.

The United States, Japan, and Europe are the main consumer markets for shrimp and import both wild-capture and farmed shrimp from other producer countries in order to meet internal demand. As pertains to US imports of wild-capture shrimp, the US Congress passed an important law in 1988 (Public Law 101-162, Section 609) that prohibited imports of shrimp and shrimp products harvested in a manner that may adversely affect sea turtles. In essence, countries wanting to send shrimp to the US had to adopt fishing methods that would protect sea turtles or only harvest shrimp in areas where turtles are not found. Adoption of turtle excluder devices (TEDs) was often the simplest method of achieving this goal and TEDs have since been adopted in many, but not all, fisheries around the world. The European Union does not have a comparable law, and thus it may provide a market for shrimp harvested without TEDs (Epperly 2003).

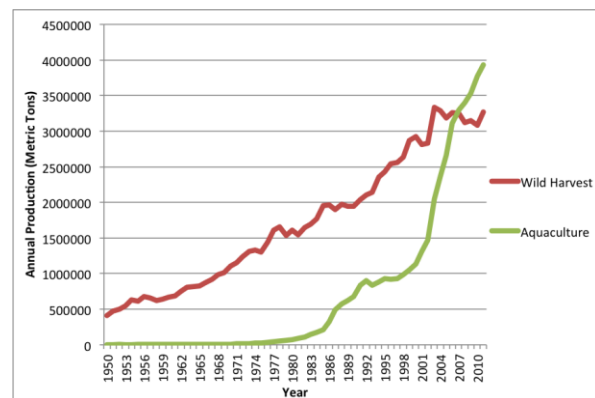


Figure 1: Wild and aquaculture global production of shrimp, 1950–2011. Aquaculture production of shrimp surpassed wild capture in 2007, and has since climbed to 60% of global shrimp production (Fish Stat J 2013).

Aquaculture shrimp production is an important determinant of wild-capture shrimp market dynamics. A larger proportion of farmed shrimp is exported in comparison with the exported proportion of wild-capture harvest. Warm-water shrimp fishery harvests fluctuate greatly with environmental conditions, while aquaculture generally can produce a steady, reliable supply. Aquaculture is often also more cost-effective than wild-capture fisheries, with rising fuel prices playing a role in these trends. Such factors lend aquaculture an export market advantage. However, aquaculture has thus far proven unable to produce larger body sizes, which allows wild shrimp to maintain an upper-end market niche.

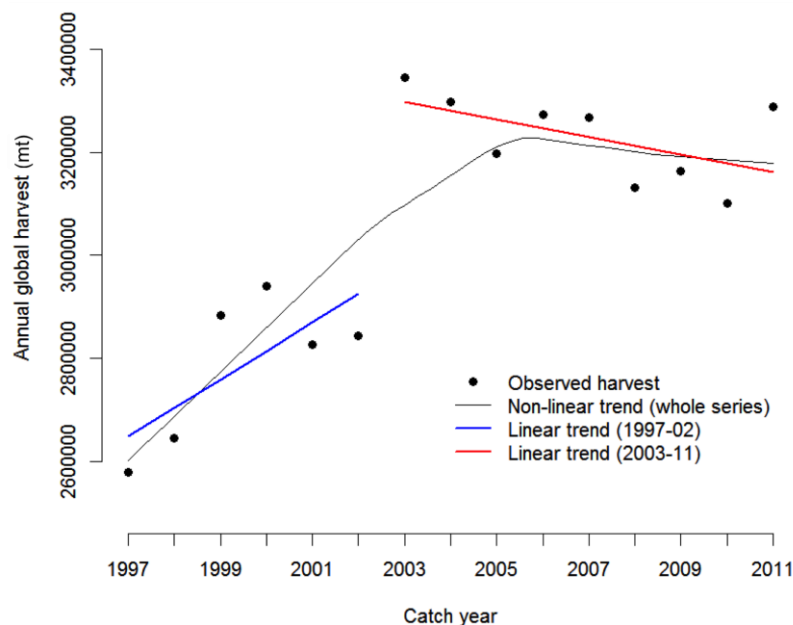


Figure 2: A regression analysis of the global wild-capture shrimp harvest, 1997–2011. An increasing trend is visible through 2002, followed by a historic peak in 2003, and then declines.

Continuing upward trends in aquaculture production may hinder the international supply chain's ability to leverage sustainability improvements in high wild-capture production regions. As aquaculture grows and more wild-capture shrimp is relegated to domestic markets, domestic supply chains will need to be engaged in improvement efforts as well. Aquaculture can also compete with wild fisheries not only for markets, but also for mangrove

habitats (possible farm locations vis à vis wild juvenile rearing habitat) and harvest of egg-bearing females (many farms are dependent upon wild harvest for use as brood stock).

Scoring Results

A total of 66 stock- and fishery-scale profiles have been evaluated for performance against the five FishSource criteria and sorted into categories, with results summarized in spreadsheets #1–3 of the Annex. An overview of notable results follows:

- Among warm-water shrimp fisheries profiled in FishSource, which account for 42% of the total global harvest volume of warm-water shrimp, 0.9% of the total catch volume comes from fisheries in very good condition (Category A), 8.8% comes from fisheries that are in good condition but would benefit from improvements (Category B), 42% originates with fisheries in need of significant improvements (Category C), and 48.3% is harvested by fisheries that could not be scored due to data deficiency (Figure 3).
- Among cold-water shrimp fisheries profiled in FishSource, which account for 61% of the total global harvest volume of cold-water shrimp, 12% of the total catch volume comes from Category A fisheries, 73% originates with Category B fisheries, and 15% is harvested by Category C fisheries (Figure 4).

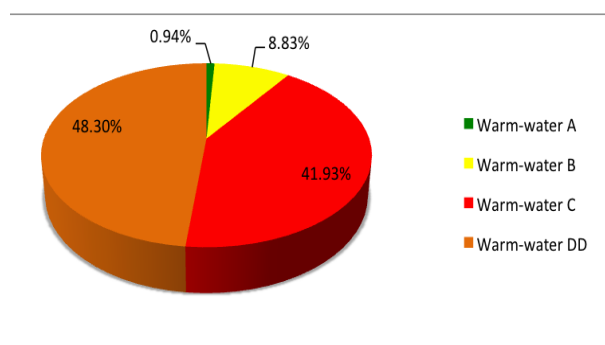


Figure 3: 42% of global warm-water shrimp harvest volume is represented in FishSource,. Only 9.5% of this volume is accounted for by fisheries rated as Category A or B. Most falls into Category C or is Data Deficient.

- A comparison of warm-water to cold-water shrimp fisheries reveals a greater need for improvement in warm-water fisheries, with 90% of volume originating from Category C or Data Deficient (DD) fisheries versus 14.5% of cold-water fisheries in those two categories (Figures 3 and 4). Similar results are not available at this time for paste shrimp.

- Further examination of the scores and rationales that generated Category C classifications indicates that different issues exist among warm- and cold-water shrimp fisheries, and the two types of fisheries also have their own geographic specificities:

- Among the 20 warm-water fisheries that were rated as Category C, issues with illegal, unreported, and unregulated (IUU) harvest contributed to the fishery's classification in 90% of cases. 80% of the Category C fisheries also received low marks due to managers' inability to translate best available science into management measures.
- Developing countries account for 89% of Category C warm-water shrimp harvest. Meanwhile, American and Australian fisheries comprise 79% of warm-water Category A and B volume.

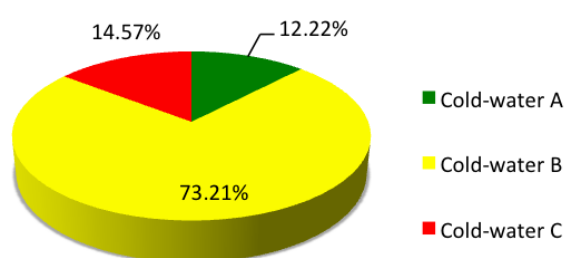


Figure 4: FishSource represents a greater share of cold-water shrimp global harvest than that of warm-water shrimp (61%). Of the represented volume, 87% of global harvest falls into Category A or Category B, reflecting more sustainable management of cold-water shrimp fisheries compared with warm-water fisheries.

- Among the nine cold-water fisheries that were rated as Category C, the absence of quantitative harvest control rules resulted in or contributed to the fishery's Category C classification in six (67%) of the cases.
- Fisheries conducted by European Union Member States account for the majority (75%) of Category C cold-water shrimp fisheries. Meanwhile, Category A cold-water shrimp fisheries are all managed by Canada.

MSC and FIP Information

Compared with other SFP seafood sectors, the shrimp sector has been comparatively slow to engage in improvement efforts:

- 17% of global shrimp harvest volume comes from fisheries that are engaged in the Marine Stewardship Council (MSC) process or in a fishery improvement project (FIP) (11.2% MSC certified, 4.3% in a FIP, 1.3% in MSC full assessment). The remaining 83% is sourced from fisheries not engaged in official improvement efforts. Meanwhile, 95% of the whitefish, 77% of the small pelagics, and 48% of the volume in the salmon sector originates with fisheries engaged in the MSC process or in a FIP.
- Cold-water fisheries engaged in the MSC program account for the majority (67%) of total global cold-water shrimp harvest volume (59% are certified, and 8% are currently in MSC full assessment).
- Warm-water fisheries certified by MSC account for only 1% of the warm-water shrimp global harvest volume. There are no warm-water shrimp fisheries currently in the MSC full-assessment phase. Fisheries engaged in credible, verifiable fishery improvement projects (FIPs) account for an additional 7% of warm-water global harvest. Paste shrimp fisheries are neither engaged in the MSC process nor in any FIPs at this time (Figure 5).

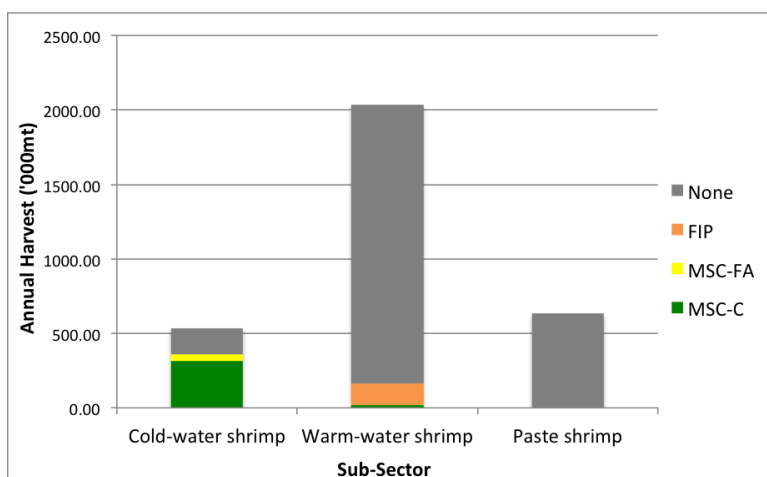


Figure 5: Shrimp fishery engagement in improvement efforts, arranged by fishery sub-sector.

Fisheries in the MSC program are assigned conditions for all scores below "80" that are received in the assessment. Conditions describe improvement actions that must be completed in order to maintain certification, as well as timelines within which these activities must occur. Annual surveillance audits describe progress toward completion of conditions, and indicate whether or not fisheries are ahead of, on, or behind schedule with respect to the timeline.

Review of shrimp fishery performance on MSC assessments (9 cold-water and 3 warm-water fishery assessments) revealed that:

- Of 90 conditions assigned to shrimp fisheries as a part of 12 MSC shrimp fishery assessments, 17 have been resolved, 68 are open and on target to be completed in

the requisite time frame (per Certification Bodies' assessments of progress in annual audit documentation), and 5 are behind target (Figure 6).

While only 19% of shrimp fishery conditions have been closed since MSC first certified a shrimp fishery in 2007, the fact that 8 of 12 MSC shrimp fishery assessments have taken place in the last 3 years is a contributing factor. Several years of fishery improvement work is often necessary in order to close MSC conditions.

MSC conditions on Principle I (Stock Status) performance indicators match improvement needs highlighted by FishSource. Conditions regarding the need to develop quantitative harvest control rules have been assigned to cold-water fisheries, and compliance issues have been raised with a warm-water fishery (Suriname seabob). Additionally, conditions raised under Principle 3 (Effective Management) have focused upon the development of research plans and integration of best available science into management practices. However, the majority of MSC conditions for shrimp fisheries have been raised under Principle 2 (Environmental Impact), where issues regarding bycatch, habitat, and ecosystem impacts are addressed. These issues are not addressed under the ratings described in this report, but further information is included in the sub-sector improvement overviews below.

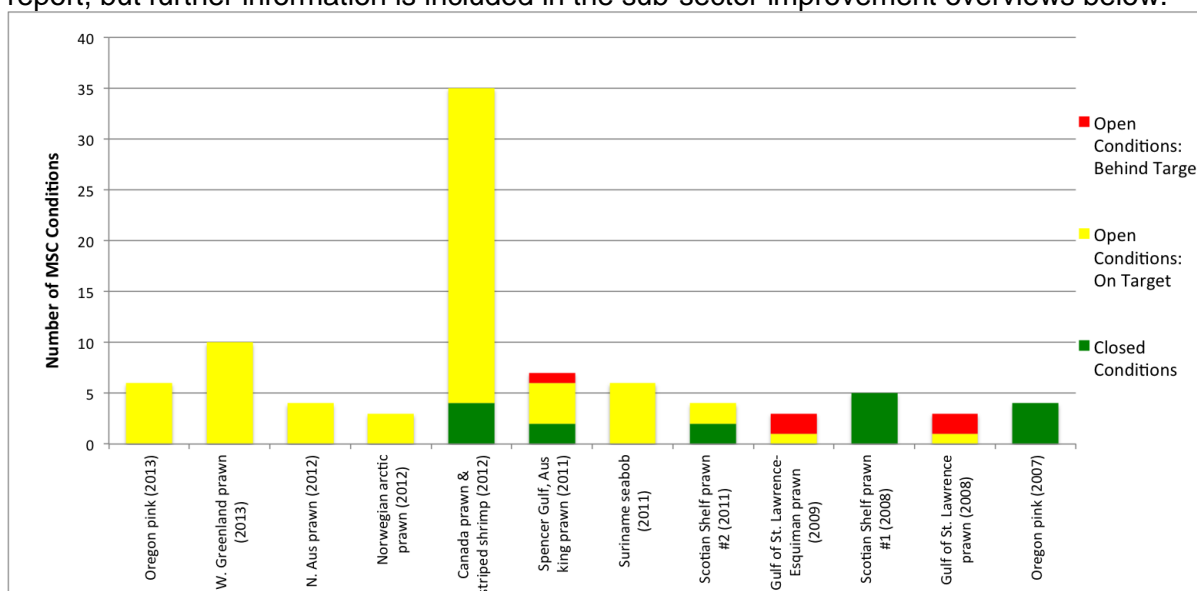


Figure 6: Performance against MSC conditions for the 12 MSC shrimp fishery assessments that have taken place 2007–2013.

Discussion: Fishery Improvement Needs

Warm-Water Shrimp Fisheries

Developing Asian nations are the leading producers of wild-caught, warm-water shrimp. Among the top ten nations for shrimp wild-capture harvest, seven focus upon warm-water shrimp and six of those are developing nations, five of which are located in Asia. The top three countries (China, India, and Indonesia) account for over half of global shrimp production (Figure 7). While mixing of farmed shrimp with wild harvest may result in inaccurate inflation of some FAO shrimp harvest statistics, it is clear that Asia is the epicenter of wild-capture shrimp harvest (Gillett 2008).

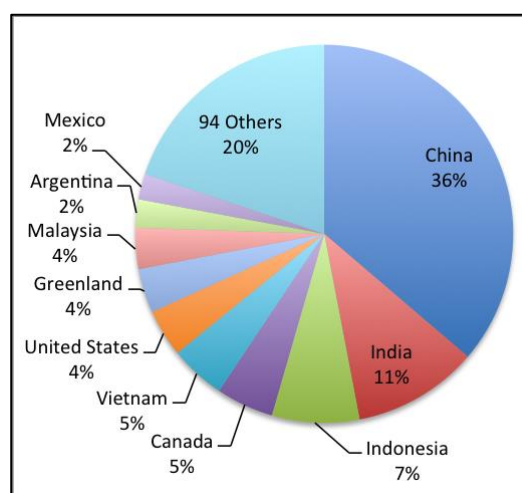


Figure 7: Proportion of global shrimp harvest by nation: the top 10 countries are represented, as well as 94 others combined together (FishStat J 2013).

Data deficiency issues among Asian warm-water shrimp fisheries represent a concern in terms of improving upon the current poor coverage of these fisheries in FishSource. FishSource only accounts for approximately one-third of harvest in FAO region 61 (Northwest Pacific Ocean) with a single, data-deficient profile for South China Sea “*Peneaus shrimp nei*” (a lumped FAO species group of penaeid shrimps). This profile alone accounts for 35% of the shrimp harvest volume included in FishSource, but cannot be scored due to the low resolution of publicly available information. FishSource coverage of the next most important FAO regions for shrimp harvest, the Western Central Pacific and Eastern Indian Oceans, is similarly poor (Figure 8).

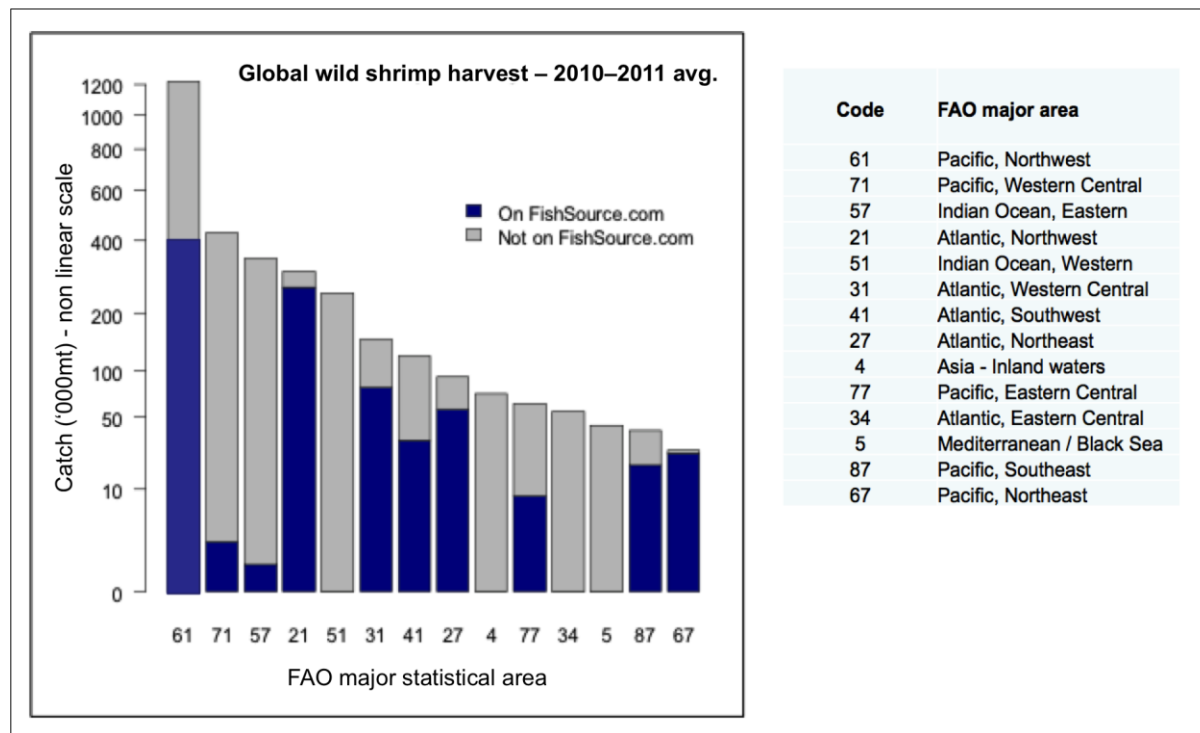


Figure 8: FishSource coverage of fisheries that account for wild shrimp harvest, organized by FAO region. Gaps in Asian coverage are visible.

A literature review of Chinese fisheries science publications indicates concern regarding overfishing and associated mean body length reductions of particular penaeids in the South and East China Seas, with researchers calling for implementation of closed seasons and other management measures to allow for recovery (Song et al. 2004; Zhang et al. 2007; Huang et al. 2009; Li et al. 2009; Li and Zhang 2012; Ye et al. 2012). Overfishing and long-term risks to shrimp stocks are elusive topics for scientists and fisheries managers. As Gillett (2008) notes, warm-water shrimp fisheries are among the easiest wild-capture fisheries to manage because warm-water shrimp are highly fecund and short-lived (generally 1–2 years), mortality and growth rates for commercial species are known, and abundance is driven mostly by climatic variability. Due to short life cycles, overfishing is immediately apparent and management mistakes can often be mitigated for within one year. Furthermore, as most warm-water shrimp fisheries harvest several species, a bad year across all species is unlikely.

Many global shrimp fisheries are managed quite simply, relying upon Catch Per Unit Effort (CPUE) data to track abundance changes. To the knowledge of the authors, few shrimp stock declines attributable to overfishing have been described in the scientific literature. However, recruitment overfishing has been documented for shrimp populations in Western

Australia (Penn and Caputi 1986).⁴ A 2011 analysis indicated that CPUE indices are in decline for many global shrimp fisheries (Poseidon 2011). Furthermore, strong interest in previously unexploited, deepwater species is visible in recent scientific literature and conference proceedings, and possibly fueled by overexploitation of coastal resources (Crustacean Society 2013). In light of the existence of clear risks, fisheries with CPUE-based management are called upon to improve stock assessment capabilities and gather more species-specific data on abundance and population dynamics.

Most warm-water shrimp fisheries are input- rather than output-controlled, and therefore fishers' compliance with gear, effort, and area regulations is of particular importance. Improved enforcement is the focus of ongoing fishery improvement work in the Magdalena Bay, Sinaloa Nayarit, Sonora, and Upper Gulf of California shrimp fisheries of Mexico. With respect to industrial fisheries, mandatory Vessel Monitoring Systems, some on-board observer coverage, and sufficiently harsh penalties for both fishing violations and government corruption are facets of successful enforcement. Enforcement efforts are complicated at the artisanal fishery scale by the large number of vessels and landing sites, and the resultant impracticality of implementing observer networks. Area and seasonal closures or no-fishing zones can be more successful control measures when dealing with artisanal fisheries.

Managers and researchers have known for a long time that demersal or bottom trawling gear is associated with higher bycatch rates than other fishing gears in use today. Shrimp fisheries have the highest discard rate among all major global fisheries due to the predominance of trawling gear in the sector. However, efforts to develop alternative gears in shrimp fisheries have failed. Complete bans of industrial trawling in favor of entirely artisanal fisheries have been enacted by some countries, most prominently by Indonesia in the 1980s. Indonesia's motivation was less environmental and more social (prevention of antagonism between artisanal and industrial fishermen) (Butcher 2004). The popularity of industrial trawl bans has recently experienced a revival in Latin America, where Chile, Ecuador, Venezuela, and, most recently, Costa Rica have all enacted bans on industrial bottom trawling. Latin American countries have also prominently established closed areas defined by water depth that are closed to shrimp trawling.

Bycatch is particularly high in warm-water shrimp fisheries, where target species can account for as little as 1/15 of catch (Poseidon 2011). Bycatch reduction device (BRDs) and turtle excluder devices (TEDs) can be integrated into trawling nets in order to eject bycatch from nets, but they have sometimes been unpopular with fishermen and problems can arise from incorrect installation.⁵ Fishery improvement projects underway in Florida, Texas, and federal US waters of the Gulf of Mexico are focused upon organization of third-party gear inspections to ensure that BRDs and TEDs are installed properly and operating at peak performance. Another focus of these FIPs is to accomplish better analysis of the status of main bycatch species.

The MSC-certified Australian Northern prawn fishery currently sets the gold standard for bycatch research. That fishery has high discard rates, but it has undertaken detailed modeling and research in order to demonstrate that current bycatch rates are not resulting in

⁴ Growth, economic, and ecosystem overfishing are also clear risks for shrimp fisheries. Approximately 5% of global harvest (and up to half of the harvest in some countries) is attributable to coastal, artisanal fisheries, which are notoriously difficult to manage in terms of enforcement and compliance. These fisheries are at greatest risk of harvesting shrimp before they achieve sexual maturity. Industrial trawling operations, meanwhile, are expensive to operate and have the highest bycatch rates of global fisheries, resulting in risk of economic and/or ecosystem overfishing.

⁵ Turtle excluder devices (TEDs) are bycatch reduction devices (BRDs) specifically intended for the reduction of turtle bycatch. In warm-water shrimp fisheries, TEDs are installed in trawl nets along with finfish excluder devices (another type of BRD). The finfish excluder device allows small fish that fit through the TED bars to escape from the cod end of the net. When the term "BRD" is used as pertains to warm-water shrimp fisheries, it generally refers to the finfish excluder device, while the specific term "TED" indicates the device used to reduce turtle bycatch.

detrimental effects to bycatch species or the ecosystem. Although high discard proportions can be sustainable when research indicates that neither the bycatch species are endangered nor is the ecosystem unbalanced as a result of the fishery, civil society can perceive large discard volumes as wasteful and unethical—an opinion that should be taken into account by retailers when assessing the risk of sourcing from particular fisheries.

Cold-Water Shrimp Fisheries

Cold-water shrimp fisheries occur in temperate and arctic waters throughout the world (northern and southern hemispheres), targeting a variety of species. Northern prawn (*Pandalus borealis*) is the most important cold-water shrimp species in terms of harvest volume, and is the target of all cold-water shrimp fisheries currently included in FishSource. Over the last several years, some northern prawn fisheries in the Northwest Atlantic have exhibited declining trends in abundance and recruitment. Current closures of the Flemish Cap and Gulf of Maine fisheries are associated with these trends, which have been attributed by fishery managers to environmental conditions such as cod predation (Flemish Cap) and temperature regime change (Gulf of Maine).

While FishSource has focused on northern prawn to date, global fisheries target other cold-water shrimp species as well, and the market value varies widely among the different species. The more populous northern prawn and pink shrimp (*Pandalus jordani*) have less value per unit weight than more specialty species such as Spot prawn (*Pandalus platyceros*), Sidestripe shrimp (*Pandalus dispar*), Coonstripe shrimp (*Pandalus hypsinotus*), and Dock shrimp (*Pandalus danae*).

Most cold-water shrimp fisheries are output-controlled, with annual catch limit recommendations developed by scientific advisory bodies and promulgated by Regional Fishery Management Organizations. Due to the longer life cycles (3–8 years) of cold-water shrimp and their limited dependence upon environmental conditions, managers successfully apply approaches based in traditional fisheries science when developing pre-season forecasts and catch limits upon their basis. Some cold-water shrimp fisheries have explicit, quantitative harvest control rules in addition to catch limits, stipulating allowable fishing mortality at various biomass levels. However, other cold-water fisheries do not have formal, quantitative harvest control rules in place, resulting in low scores on FishSource Criterion 1. This is mirrored in some MSC assessments of cold-water fisheries (Canadian Northern prawn Areas 1–7, Norway Northeast Arctic prawn), in which conditions have been assigned to fisheries stipulating that harvest control rules need to be established and put into place.

Bycatch issues in cold-water fisheries are less severe than in warm-water fisheries, as northern ecosystems are less diverse than tropical ecosystems and sea turtles are less abundant. However, bycatch volume in cold-water shrimp fisheries can be significant. The Nordmore grid, a BRD used in Atlantic cold-water shrimp fisheries since the late 1980s, has been instrumental in reducing finfish bycatch. When the grid was first introduced into the Canadian Northern prawn fishery, managers established areas where fishers could only enter if using a net equipped with a grid. After the fleet perceived success of the first few fishermen to adopt the grid and access the restricted areas, voluntary use of the grid ensued (Gillett 2008). The Nordmore grid is more effective with ejecting adult fish than juveniles, and therefore an effective cold-water shrimp fishery bycatch management plan will include seasonal and temporal closures to protect juvenile finfish.

One of the most common conditions raised in MSC assessments of shrimp fisheries addresses benthic habitat impacts of trawling. When trawls slide along the seafloor bottom, they can compress sediments, reduce productivity and diversity of benthic communities, and flatten natural surface structures. MSC certifiers have called upon assessed shrimp fisheries, cold- and warm-water alike, to conduct benthic mapping and identify sensitive areas that require additional protection, as well as assess habitat impacts of fishing. For more

information, see SFP's report, [Benthic Protection Areas: Best Practices and Recommendations](#).

Paste Shrimp Fisheries

FishSource has not yet profiled any *Acetes*-focused fisheries, but hopes to represent this sub-sector in the near future. China's average annual harvest of Akiame paste shrimp (*Acetes japonicus* and *Acetes chinensis*) in 2010–2011 comprised 17% of average total global shrimp harvest (FishStat J 2013). Akiame paste shrimp are the single most important shrimp species group in terms of harvest volume.

Chinese fisheries for *Acetes* are artisanal, harvesting the shrimp in coastal staked set nets known as "stow nets," the most important, global, non-trawl gear for shrimp in terms of tonnage. As of the mid-1990s, there were 350,000 of these stow net plots along the Chinese coastline. The bag-like nets have a minimum mesh size of 55mm per Chinese Ministry of Agriculture [regulations](#) in order to harvest the 1–4cm-long shrimp. With very short life cycles, *Acetes* population dynamics are even more dependent upon environmental conditions than penaeids. For this reason, and the artisanal nature of fisheries that target the species group, data deficiency, and lack of adequate harvest monitoring and control measures are likely currently the most important problems in this sub-sector. There are also bycatch issues: despite the coastal, passive nature of the gear, the small mesh size of the nets catches anything that crosses its path. Very little of what is harvested by small-scale Southeast Asian and Chinese fisheries is discarded—low-value, small bycatch species are often used for aquaculture feed. These fisheries are often poorly regulated and do not accurately account for landings of each harvested species (Gillett 2008).

Recommendations to Retailers and the Supply Chain

Retailers and suppliers of shrimp are called upon to participate in existing FIPs, particularly those in the Gulf of Mexico, United States, and Gulf of California, Mexico, as well as initiate FIPs in fisheries that are neither currently engaged in the MSC process nor in a FIP from which they source product. Priority fisheries for FIP initiation include those in the top 10 wild shrimp producer countries (Figure 7) without current, public engagement in credible, verifiable fishery improvement activities: China, India, Indonesia, Vietnam, Malaysia, and Argentina.

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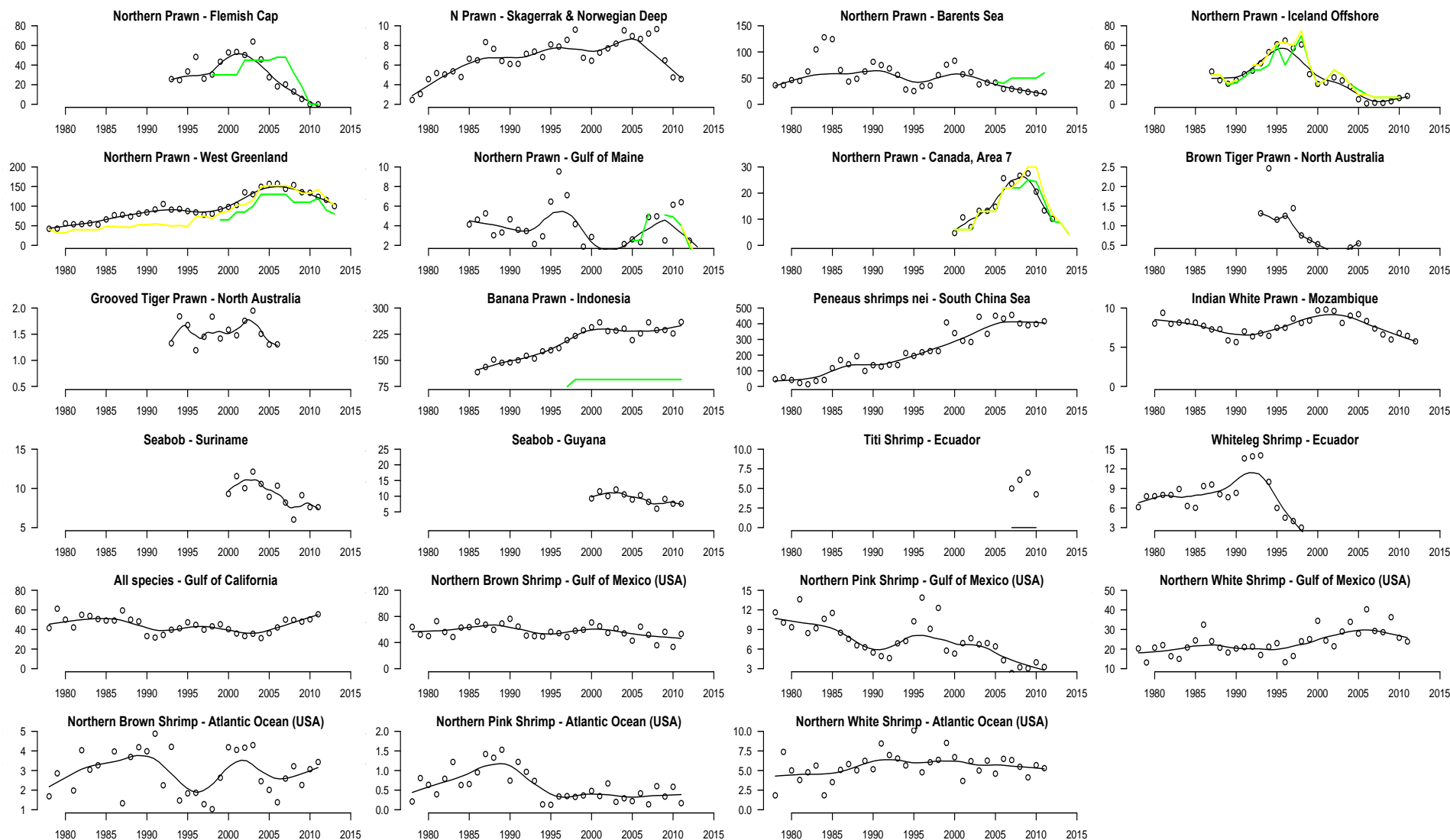
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Appendix A: Recent harvest trends in various shrimp fisheries. Advised Total Allowable Catch (yellow) and set Total Allowable Catch (green) are shown for fisheries with TAC-based management (FishSource 2013).



Appendix B: Recent biomass trends in various shrimp fisheries. Limit reference points (red) and target reference points (green) are shown for fisheries managed to achieve reference points for biomass (FishSource 2013).

