Warm water prawns, as their name suggests, are located in tropical marine areas. Total world production of penaeid (family Penaeidae) shrimps and prawns averaged 4.78 million tonnes per annum for the years 2008-10 (1). Of these 3.57 million tonnes or 75% were produced by aquaculture, pre-dominantly from inland (brackish water) locations (87%). In contrast, 98.4% of wild caught penaeids were from marine areas.

Two species dominate aquaculture, the white leg prawn (Litopenaeus vannamei formerly Penaeus vannamei) and the giant tiger prawn (Penaeus monodon) with 70% and 21% of world annual production (average 2008-10) respectively. The remaining 9% of aquaculture production is made up of a further six minor species (Table 1). On the UK market the legal distinction between penaeid prawns and shrimps is based on weight; the fish labelling regulations (2) should be consulted for details. Scientific names have changed recently (see Table 1).

In 2007, AC Nielsen valued the UK retail market for warm water prawns at £183m, with a year on year growth rate of around 14%. With more than 60% of warm water prawns sold through foodservice and other trade channels, the retail value of the UK warm water prawn market may be estimated in the region of £450 million.

Table 1. Scientific names penaeid prawns/average production pa.

<table>
<thead>
<tr>
<th>Previous scientific name (3)</th>
<th>Current scientific name (3)</th>
<th>Production (1) Av t 2008-10</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penaeus vannamei</td>
<td>Litopenaeus vannamei</td>
<td>2,488,172</td>
<td>70</td>
</tr>
<tr>
<td>Penaeus monodon</td>
<td>Penaeus monodon</td>
<td>757,020</td>
<td>21</td>
</tr>
<tr>
<td>Penaeus spp</td>
<td>Various</td>
<td>109,478</td>
<td>3</td>
</tr>
<tr>
<td>Penaeus japonicus</td>
<td>Marsupenaeus japonicus</td>
<td>52,910</td>
<td>1</td>
</tr>
<tr>
<td>Penaeus chinensis</td>
<td>Fenneropenaeus chinensis</td>
<td>44,163</td>
<td>1</td>
</tr>
<tr>
<td>Penaeus merguiensis</td>
<td>Fenneropenaeus merguiensis</td>
<td>42,725</td>
<td>1</td>
</tr>
<tr>
<td>Penaeus indicus</td>
<td>Fenneropenaeus indicus</td>
<td>36,166</td>
<td>1</td>
</tr>
<tr>
<td>Metapenaeus spp</td>
<td>Various</td>
<td>34,249</td>
<td>1</td>
</tr>
<tr>
<td>Metapenaeus monoceros</td>
<td>Metapenaeus monoceros</td>
<td>5,599</td>
<td>0.002</td>
</tr>
<tr>
<td>Penaeus stylirostris</td>
<td>Litopenaeus stylirostris</td>
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<td>0.001</td>
</tr>
<tr>
<td>Metapenaeus ensis</td>
<td>Metapenaeus ensis</td>
<td>430</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

BUYERS’ TOP TIPS

Know your source of supply. Only purchase prawns which are traceable throughout the entire production chain.

Ensure product complies with appropriate standards for farming, processing and production.

Understand the legal system for importing prawns, and the testing requirements to ensure all product is free from drug and chemical residues.

Be aware of the social and environmental impacts.

Responsible Sourcing Services. See: http://www.tinyurl.com/seafishrsg
Sources and quantities

Figure 1 shows China, Thailand, Indonesia and Viet Nam dominate production of warm water prawns. Production (Figure 2) has grown rapidly from around 1 million tonnes in 2000 to over 3 million tonnes in 2010.

Figure 1. Total production of 3,573,024 tonnes of farmed shrimps and prawns by country in 2010 (FAO statistics).

Figure 2. Trajectory total world production farmed shrimps and prawns 1980-2010 (FAO statistics).
Biology and cultivation method

Penaeus monodon is native to the coasts of the Indian ocean, and from South Africa to Australia including South East Asia. Litopenaeus vannamei is native to the west coast of the Americas from Mexico to Peru. However, both species are cultivated outside their native range.

Cultivation of Penaeus monodon (4)

Depending on substratum, feed and water turbidity, the body colour of Penaeus monodon varies from green, brown, red, grey and blue. Transverse band colour’s on abdomen and carapace are alternated between blue or black and yellow. Adults may reach 33cm in length (>150g in weight) and females are commonly larger than males. These prawns breed only in tropical marine habitats and spend their larval, juvenile, adolescent and sub-adult stages in coastal estuaries, lagoons or mangrove areas, whilst adults are found offshore on muddy and sandy bottoms in waters of 20-50 m deep.

It is cultured in the Indo West Pacific, East and South East Africa, Madagascar, Pakistan, Japan, the Malay Archipelago and Northern Australia. Traditional pond culture can involve the trapping and holding of juvenile shrimp brought in by tidal water. However, during the 1970s breeding, hatchery and on growing techniques were developed, enabling the species to be cultivated from broodstock. Normally broodstock are captured from the wild. They are stabilised, graded and subsequently induced to spawn. It has been found that unilateral eyestalk ablation (removal of one eye) has the effect of stimulating the endocrine system which in turn results in ovarian development. However, the mechanism is not fully understood and research continues to find alternative methods for inducing maturation. Larvae are cared for in nursery rearing tanks. Once they have developed into the post larvae stage (young adults) they are transferred to either a traditional, extensive or semi-intensive pond. Growth units range in size from small ponds on a subsistence basis to very large industrial size operations.

On-growing culture practices

There are three on-growing culture practices: extensive, semi-intensive and intensive, which represent low, medium and high stocking densities respectively. Due to its benthic feeding habit Penaeus monodon is commercially cultured only in earthen ponds, under widely varying salinities from 2 to 30‰.

- **Extensive**

This technique is generally carried out using wild seed either entering the ponds naturally on the tide, or purchased from collectors. Extensive ponds larger than 5 ha are constructed and fertilized with organic and inorganic fertilizers, and are stocked at the
rate of two animals per m² and harvested at six months. The shrimp feed on natural foods enhanced by pond fertilisation, and supplemented by artificial diets. Water exchange of 10-15% is carried out daily. Yields are relatively low at 50-500 kg/hectare per annum. Most farmers are upgrading their methods to semi extensive and intensive cultivation.

- **Semi intensive cultivation**

Semi-intensive ponds (approximately 1 ha) are stocked with hatchery produced seeds at the rate of 20-25 young prawns/m². Water exchange is regularly carried out by pumping. Aerators are used for maintaining desired levels of dissolved oxygen. Feeding is by natural foods enhanced by pond fertilisation and supplementary feeding. Production levels of 500 to 5,000 kg/ha/year are achieved.

- **Intensive cultivation**

Ponds are generally small (0.1-1.0 ha) and they are stocked at higher densities with 20-60 young prawns/m². There is vigorous aeration, and regular feeding four-five times per day. Tidal exchange is limited, especially where there is risk of disease, when closed systems may be used, and there has to be careful monitoring and management of water quality. Final feed conversion ratios of between 1.2 and 2.0:1, and production of 4,000 to 15,000 kg/ha/year, can be achieved. Careful management of food is important to the success of these farms, particularly as *Penaeus monodon* has the habit of slowly nibbling food on the pond bottom, this can cause nutrient losses since the pellets may breakdown before they are consumed.

**Research**

Cultivation of *Penaeus monodon* remains less scientifically advanced than *Litopenaeus vannamei* (see below) and is the subject of ongoing research. Issues which are being addressed include domestication (being able to cultivate the species through its entire lifecycle rather than rely on wild brood stock), which would enable the development of disease resistant brood stock. Also the treatment of shrimp viruses, replacement of non-environmentally friendly and costly fishmeal and Artemia (brine shrimp) in shrimp feeds, and improving water treatment for closed systems.

**Cultivation of Litopenaeus vannamei (5)**

This species grows to a smaller size (23 cm or 100 – 150g) than *Penaeus monodon*. Its normal appearance is a translucent white, but colour may vary dependent on substratum, feed and water turbidity. In the wild, the lifecycle is similar to *Penaeus monodon* with the adults living and spawning in the open ocean, while larvae migrate inshore to spend their juvenile, adolescent and sub-adult stages in coastal estuaries, lagoons or mangrove areas.
Cultivation techniques

Cultivation techniques for *Litopenaeus vannamei* are analogous to *Penaeus monodon*, but differ in several respects:

- *Litopenaeus vannamei* broodstock free from specific pathogens can be purchased from the United States, bypassing the need to use wild stock.

- The animals are less carnivorous than *Penaeus monodon* so their protein requirements are lower which makes them cheaper to feed. Use is made of the ‘bacterial floc’ system, whereby bacterial growth is encouraged in the tanks under controlled conditions. The prawns feed on the floc thereby improving efficiency of nitrogen uptake. Feed Conversion Ratios of 1.2 – 1.8:1 are generally obtained but lower ratios are obtainable.

- Research into super intensive cultivation has been carried out in the United States. In these systems prawns are cultivated in enclosed raceways housed in greenhouses. In these systems the water is treated and re-used; there is no effluent stream and only evaporative losses are replaced. It is claimed that these systems are very cost effective and have a low ecological footprint, but they have yet to prove themselves commercially.

In general, production of *Litopenaeus vannamei* is more scientifically and technologically advanced than for *Penaeus monodon*, with disease resistant strains available. There is more intensification of farms, and they can be cultivated in almost freshwater which reduces the risk of salt damage to soils (see below).

Environmental considerations

The rapid growth in production of these species and the potential environmental, social and economic effects of their culture, have led to the need to develop standards for culture to ensure control of these effects.

Farmed shrimp can potentially suffer from a number of bacterial, viral, fungal and parasitic diseases. Counter measures include careful pond husbandry to ensure good water quality to avoid stressing the prawns, regular cleaning of pond bottoms and careful sourcing of stock to avoid infected animals entering the stock. Disease-free (SPF; Specific Pathogen Free) and disease resistant (SPR; Specific Pathogen Resistant) stock are available for *Litopenaeus vannamei*.

Whilst for viral pathogens there are no countermeasures, except good husbandry and avoiding infected stock, there are a number of treatments available which are used by prawn farmers, either to prevent or control infection from bacterial and other sources. Administering veterinary medicines or other pharmacologically active substances may result in medicine residues persisting in prawn flesh. Since these residues are generally undesirable, and some potentially hazardous to human health, legislation is in place to control use and limit residues in the final product.
In the EU, veterinary medicines may be used only if they are on a ‘permitted’ list. Medicines that are not listed, such as methyl violet, or that are on a ‘banned’ list, such as chloramphenicol and the nitrofuran drugs, should not be used at all. Consignments of shrimps containing even the smallest detectable residue of these drugs are not allowed on the market and will be destroyed by the authorities (6).

Testing is carried out on entry to the EU and samples are taken in relation to the perceived risk of contamination at source. Love et al (7) examined the results of seafood testing regimes for residues of hazardous substances in the United States, European Union, Canada and Japan for the period 2000 to 2009. Whilst testing revealed residues in some seafood sources, including prawns, it was not possible to estimate the proportion of imported seafood that contains residues, because investigations tended to target specific products from high risk locations; randomized sampling, which would enable an overall human population exposure to be estimated, was not routinely carried out.

WWF has listed (8) environmental and social issues that could relate to prawn production, which are substantially the same as those listed by the FAO (4,5):

- **Farm design**: Ecologically-sensitive habitat, such as mangrove forests, can be cleared to create ponds for shrimp production.
- **Water use/pollution**: Salt water from prawn farms can seep into the groundwater and onto agricultural land (called salinisation); organic waste, harsh chemicals and antibiotics from prawn farms can pollute the water; and aquifers can be drained to supply water to prawn farms.
- **Feed**: Wild stocks of fish can be depleted for use in formulated feeds for prawn production.
- **Broodstock**: Negative biodiversity impacts can arise from the indiscriminate collection of wild brood and seed.
- **Pathogens**: The introduction of pathogens can lead to major prawn disease outbreaks and significant economic losses in producing countries.
- **Socio-economic issues**: Jobs can be eliminated if there are fewer wild caught prawns to harvest as a result of mangrove loss and/or shrimp farms are shut down due to disease outbreaks; public access to land and shorelines can be restricted.

There are a number of measures available to counter these negative aspects. Examples include intensification of culture using recycling systems, and a very minimal amount of seawater, to prevent salinisation of soils and freshwater resources. The intensive systems do not use tidal mangrove areas, thus reducing the effects on these sensitive habitats. Domestication of *Litopenaeus vannamei* has reduced the requirement to obtain wild seed and wild brood stock and helped to control disease. Whilst these measures can be taken to counter the potentially adverse effects of prawn aquaculture, there is a requirement to adapt these to the particular circumstances of each operation against a set of independent standards.
Management standards and certification

Both environmental and economic pressures support the need for management standards and certification of aquaculture production. Certification is a process that allows a supplier to demonstrate responsible sourcing practices by: minimising impact on the environment; making the best use of locally available resources; making informed choices regarding labour rights; complying with national legislation and ensuring the best use of feed and therapeutic products.

The development of aquaculture standards is underway through a variety of organisations, including the Global Aquaculture Alliance, GLOBALG.A.P. and WWF through the WWF Aquaculture Dialogues, now housed by the Aquaculture Stewardship Council (ASC). For the responsible sourcing and production of fishmeal and fish oil (key ingredient in prawn diets) there is the IFFO Global Standard for Responsible Supply (IFFO RS). In January 2011 FAO approved technical guidelines on the certification of aquaculture (9). Certification schemes overall have been reviewed and compared by MRAG (10) against draft FAO technical guidelines.

- **GLOBALG.A.P Good Agricultural Practice** (11) is a private sector body that sets voluntary standards for the certification of production processes of agricultural (including aquaculture) products around the globe. The standard serves as a global reference system for other existing standards. It is a business to business (B2B) label and not directly visible to consumers.

- Standards for shrimp (prawn) were launched in April 2008.

- The **Global Aquaculture Alliance (GAA)** (12) is an international, non-profit trade association, registered in the USA, that promotes advancement in environmentally and socially responsible aquaculture. The GAA has developed Best Aquaculture Practices (BAP) certification standards for aquaculture products and offers a consumer-facing logo. GAA completed Best Aquaculture Practice (BAP) Standards for shrimp (prawn) farms in 2004.

- WWF initiated the **Shrimp Aquaculture Dialogue process** (8) which engaged with many industry, government and non-governmental organisations in an effort to reach agreement on principles and standards for the Aquaculture Stewardship Council certification scheme. The Dialogue concluded in December 2011 but field-based evaluations and refinement of the audit manual are ongoing. ASC hope to publish the shrimp standard later in 2013 (13). ASC also offers a consumer-facing logo.

- The **Sustainable Fisheries Partnership (SPF)** (14) operates Aquaculture Improvement Partnerships (AIPs), which are alliances of producers, suppliers and buyers working together to address relevant issues. SPF does not operate a certification process.
Product characteristics

Warm water prawns are an extremely good source of protein, yet are very low in fat and calories, making them a very healthy food choice (15). They are also considered a healthy option because they contain high levels of Omega-3 fatty acids and are rich in Vitamins E and B12, phosphorus and selenium.

Terminology

For convenience, prawns and shrimps are divided into cold water (16, 17) and warm water varieties. The former from cold water oceans such as the North Atlantic and Arctic, and the latter from warm waters such as the Pacific and Indian oceans.

On the UK market the legal distinction between penaeid prawns and shrimps is based on weight (2), with larger animals often called prawns such as king and tiger prawns, and smaller animals described as shrimp - but in reality the terms are often used interchangeably. For example, in the USA penaeid prawns are called shrimp.

Supply chain standards

Responsible practice in the chilled and frozen supply chain depends on correct catching, harvesting, de-heading, washing, chilling or freezing, processing and other handling practices throughout the chain. There are standards which cover these aspects from capture to retailer:

• British Retail Consortium (BRC) Global Standard & Safe & Local Supplier Approval (SALSA) certification both have HACCP-based standards and certification programmes to assure high standards in the seafood processing and wholesaling sectors.

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For further information contact:
Bill Lart T: 01472 252323 or E: w_lart@seafish.co.uk
Karen Green E: k_green@seafish.co.uk
For further guides see: http://tinyurl.com/seafishrsg