There are more than 40 commercial species of scallop exploited worldwide, of these 18 species account for the greater part of the 2.5 million metric tonnes (mt) live weight global production from both capture fisheries and aquaculture (1). Since the 1970s, cultivation of scallops has increased rapidly and now accounts for nearly 70% of total production. Scallops command a high price and frequently exported from producer countries to major markets in Europe, the US and the Far East.

The purpose of this guide is to give buyers background information on the responsible sourcing of farmed scallops.

Sources and quantities

While feed is generally perceived to be a major constraint to aquaculture development, one-third of all farmed food fish production (20 million metric tonnes) is currently achieved without artificial feeding. Oysters, mussels, clams, scallops and other bivalve species are grown with food materials that occur naturally in their culture environment - in seas and lagoons (2).

Global capture fisheries cannot meet current demand for scallop due to overfishing and increased market demand therefore scallop farming has become an increasingly important global aquaculture activity (Figure 2) (3). World mollusc aquaculture production in 2012 was 15 million mt, represented by 5 main groups (ranked in order of production importance) clams, oysters, mussels, scallops, and abalones. Scallop production was around 1.52 million mt (4).

Figure 2. Global mollusc production trend (3)
History

Scallop cultivation was developed in Japan in the late 1960s where it rapidly restored production to levels lost through overfishing (5). The Japanese success encouraged many other countries to cultivate scallops. Some have been highly successful.

In China, culture of the local zhikong scallop (*Chlamys farreri*) started in the 1970s, followed in 1982 by bay scallops (*Argopecten irradians*) imported from the US. For both of these species it was not possible to collect naturally produced spat so large-scale hatchery culture was developed, followed by suspended culture in the sea.

Such was the growth of the industry that by 1997, 1 million mt of cultivated scallops were produced (6). Furthermore, as the cultivated stock of zhikong scallop increased, natural spawning also increased enabling natural spat collection. Today, there is virtually no hatchery production of this species, but in recent years there has been a sharp fall in zhikong scallop production caused by summer mortalities. To compensate there has been expanded production of non-native bay and Japanese yesso scallops (*Patinopcten yessoensis*).

After China and Japan, the third largest scallop aquaculture producer is Peru, followed by Chile. Chilean culture of the Peruvian calico scallop (*Argopecten purpuratus*) started in the 1980s and is based on highly variable natural settlement on collectors, supplemented by hatchery production. Planned scallop production and the efficient use of aquaculture facilities is possible as hatcheries can produce spat virtually all year round. Peru followed similar methods and with warmer waters and cheaper labour now exceeds Chilean production (7).

More recently both Chile and China have advanced with trials to cultivate imported Great Atlantic scallop (*Pecten maximus*) and if proved successful, this could have significant implications for European producers and markets.

European Imports (8)

The EU market is dependent on scallop imports. In 2013, 36 million mt of frozen scallops with a value of €324 million were imported by the EU, and 60% of the total import value consisted of imports from outside the EU, from so called ‘third’ countries.

EU imports of fresh or chilled scallops in 2013 were 19 million mt and amounted to €142 million. EU imports of frozen scallops from third countries mainly come from Northern America and Latin America. In 2013, Peru was the main supplier of frozen scallops, worth €56 million. Other important suppliers in 2013 were the USA (€50 million), Argentina (€23 million), Canada (€35 million),
Japan (€14 million), and Vietnam (€12 million).

**UK**

Although the UK has substantial wild scallop fisheries, it exports much of its production (8, 9). In terms of UK seafood imports, 1,929 mt of scallops were imported into the UK for retail and commercial services (restaurants, etc.) in 2013, valued at £20.8 million. Scallops ranked 20th in the top 35 UK retail species in the 52 weeks running up to August 2014. UK retail volume of scallops was 667 mt, worth £15.3 million in this same period (9).

Small quantities of King or Great Atlantic scallops have been cultivated in Britain and Europe (Channel Islands, France, Ireland, and Norway) for many years (10). In 2012 UK aquaculture produced only 7 mt of Great Atlantic scallop, and 0.4 mt of Queen scallop (*Aequipecten opercularis*) from Scottish waters (11).

### Biology

Scallops are filter-feeding bivalve molluscs that live mainly on sandy gravel or gravel seabeds. Large scallop species can have a life-span of up to 20 years, some are effectively annuals. The market value of scallops is closely related to their size. However, under some circumstances, particularly in cultivation, it may be economically preferable to harvest scallops at a smaller size and grow on until ready for market.

### Reproduction

At spawning (some species, including King and Queen scallop are hermaphrodites), the eggs and sperm are released into the water column, often closely synchronised to maximise fertilisation. The resulting larvae can be carried a considerable distance by the water currents before settling to the seabed typically after 30 days. Such dispersal, plus variable environmental conditions during the planktonic and early settlement stages, results in great variability in the annual settlement of juveniles (12).

The main globally cultured scallop species and their natural distributions are:

- **Bay scallop** (*Argopecten irradians*) - distributed along the Atlantic and Gulf coasts of the US
- **Zhikong scallop** (*Chlamys farreri*) - native to north China, Korea and Japan

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**BUYERS’ TOP TIPS**

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<th>Topic</th>
<th>Advice</th>
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<td>Know your source of supply and only purchase scallop which is traceable throughout its entire production chain.</td>
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<tr>
<td>Ensure product complies with the appropriate farming, processing and production standards.</td>
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<tr>
<td>Scallops can accumulate naturally occurring marine biotoxins. In Europe suppliers have to demonstrate compliance with an end product standard and its traceability to source.</td>
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<tr>
<td>Be aware of the social and environmental impacts.</td>
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- Yesso scallop (*Patinopsecten yessoensis*) - common to the northwestern Pacific, Russia, Japan and Korea
- Peruvian calico scallop (*Argopecten purpuratus*) – found in the Southeast Pacific, Chile and Peru
- King / Great Atlantic scallop (*Pecten maximus*) - native to eastern Atlantic ocean, from Norway to Spain, as well as the Azores and the Canaries

**Cultivation methods and systems** (13, 14)

Basic descriptions of the various stages for scallop aquaculture are detailed below, and shown in Figure 3.

**Spat Collection**

Scallop culture has been significantly enhanced since the 1950s due to success in natural spat collection. There are a variety of ways in which spat can be collected, including a series of mesh bags suspended in the water column on a line which is anchored to the seafloor (i.e. longlining). Mesh bags are filled with a suitable cultch onto which scallop larvae will settle. Larvae undergo metamorphosis into post-larvae spat and can then be collected and transferred to a farm site for on-growing. An intermediate culture stage may be employed to allow the development of a harder shell to prevent high mortality of scallop spat associated with early transfer.

After this phase, a wide range of techniques are used for grow-out.
Sowing Culture
In sowing culture, young scallops are released from a moving vessel and spread over a pre-selected area, chosen for its suitable habitat conditions. Growth and successful yield are dependent upon stocking density; overstocking results in reduced growth.

Hatchery
In countries where natural spatfall is poor, or in the case of introduced scallops, artificial propagation of spat occurs in shellfish hatcheries. Spat are collected from culture vessels (i.e. tanks) onto ropes or nylon nets and screens.

Nursery
The nursery phase is between hatchery and grow-out phases (in land-based or in-water seawater systems. Nursery methods vary according to country and environmental conditions. In China, scallop spat collectors (ropes or nets) are transferred to shrimp ponds or nursery areas of scallop spat collectors suspended in the water column.

Grow-out
Site selection for cultivating scallop is extremely important and factors include:
- Substrate
- Depth of water
- Salinity
- Temperature
- Exposure to air, wind and currents
- Food availability
- Water quality

Two methods are recognized for the grow-out phase of scallops: hanging and bottom culture. Hanging culture relies on either a raft or longline system that floats on the sea surface from which the cultured scallops are suspended. Scallops can be suspended in pearl, lantern, or pocket nets; ear hanging; rope culture; or plastic trays. In China, lantern nets suspended on longlines is the main form of culture for all scallops. Bottom culture employs the use of scallop-filled plastic trays or wild ranching. Seed scallop are planted in plots in the intertidal or shallow sub-tidal zones. Predator-exclusion devices (i.e., fencing) may be used.

Management standards and certification
Environmental considerations
As with all intensive mariculture, scallop cultivation has the potential for substantial environmental effects depending on the location and scale of operation. The effects of this type of bivalve aquaculture on the environment are often considered less important compared to those of finfish culture. However, bivalves due to their natural characteristics are considered...
keystone species in the ecosystem and therefore they have the ability to affect the surrounding environment in both negative and positive ways (15):

**Negative impacts –**
- Suspended culture can cause local water quality and water movement changes that affect both planktonic and seabed communities, particularly in enclosed bays with limited water exchange.
- Predator removal and intensive harvesting during seabed culture also has major effects on seabed communities.
- High-density cultivation can also promote the incidence and spread of parasites and diseases.

**Positive impacts –**
- Buffer estuaries and coastal ocean waters against excessive phytoplankton blooms.
- Remove inorganic sediments from suspension, counteracting water turbidity.
- Enhancement of water clarity can increase growth of sea grasses, important nursery habitat for many fish, crustaceans and mollusc.

Successful, sustainable scallop cultivation means maintenance of healthy environmental conditions and well-managed operations to ensure sustainable use of space.

**Microbial and bio-toxin contamination**

Like other filter-feeding bivalves, scallops can accumulate pathogens from contaminated water and natural biotoxins from harmful algal blooms. Both can pose public health hazards. Microbiological contamination with pathogenic bacteria and viruses are rarely a problem in scallops fished in uncontaminated offshore waters. However, in fixed cultivation sites, as with aquaculture, there may be more of at risk from contaminants.

There are strict legal requirements for imports of scallops (and bivalves in general) into the EU, and they must comply with EU Food Safety Law and be fully traceable. Imported scallops must comply with EU health requirements and legislation designed to ensure they are safe to eat and do not contain contaminants, chemical substances and residues threatening to human health (8).

For scallops (and other shellfish) produced here in Europe, they have to be classified in relation to their microbiological contamination. Bivalve mollusc (shellfish) harvesting areas are classified according to the extent of contamination shown by monitoring of E. coli in shellfish flesh. Treatment processes are stipulated according to the classification status of the area. Areas are classified A, B or C. In all cases, the health standards in Annex III of EC Regulations 853/2004 and the microbiological criteria adopted under EC Regulation 2073/2005 must be met. Molluscs must not be subject to production or collected in prohibited areas (16).

The Food Standards Agency (FSA) in the UK has statutory responsibility for ensuring that monitoring and classification programmes are in place to meet legal requirements (17).
In the UK, the responsibility for ensuring food safety rests with the supplier who has to demonstrate that end product standards are met, and EU Regulations define the legal obligations of food businesses to ensure shellfish placed on the market is safe to eat (18). In most scallop species biotoxins do not accumulate in the adductor muscle, so ‘roe-off’ product is usually safe. Using the correct technique for processing live scallops can prevent contamination from biotoxins in stomach contents (19).

An important caveat to the above is that species differ in their characteristics, and risk mitigation may vary between species and location. Both environmental and economic pressures support the need for management standards and certification of aquaculture production.

**Certification schemes**

Certification is a voluntary 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 in the developing world; complying with national legislation and ensuring the best use of feed and therapeutic products.

Sustainability certification is becoming increasingly important in the EU and in the UK. Although the main focus is currently on wild caught fish and farmed products (e.g. shrimp or pangasius), it is expected in the long term that the capture and farming of bivalves will also need to be certified to maintain access to the EU market, at least in northern Europe (8).

Several fisheries for mussels, clams, scallops, and oysters already have been certified by the Marine Stewardship Council (MSC) (20). Furthermore, in 2012 the Aquaculture Stewardship Council (ASC) developed a standard for the certification of cultured bivalves (21), and scallop farms in Peru are already being certified and assessed (22).

**Supply chain standards**

There are supply chain standards. The British Retail Consortium (BRC) Global Standard & Safe & Local Supplier Approval (SALSA) certification are designed to raise standards in the seafood processing and wholesaling sectors. At the end of 2014 new EU ‘Labelling of Fishery and Aquaculture products’ (FAPs) came into force. Now all wild fishery and farmed aquaculture products marketed within EU (both the EU and non-EU products) will display mandatory and voluntary information about the product for final consumers and mass caterers (31, 32).

**Product characteristics**

Farmed scallop are available all year round. Scallop meat has firm, meaty texture, and a translucent, off-white colour. It has a sweet, delicate flavour, and requires minimum cooking, steamed, pan-fried or grilled (22).
General packaging and processing characteristics (7)

Packaging: Scallops are traded in bags of 1 or 10 kg, but scallop meat can sometimes also be imported in 1 kg tins.

Processing: Scallops are often without shell, sold roe-on or roe-off.

For further information contact:
Lee Cocker. E: Lee.Cocker@seafish.co.uk
Karen Green. E: Karen.Green@seafish.co.uk

For other aquaculture guides see: http://www.seafish.org/industry-support/aquaculture
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