International trade in live molluscs: perspective from the Americas

R.A. ELSTON *

Summary: There is an active world trade in seed and edible molluscs, including such species as oysters, abalones, clams, scallops and mussels. The supply of new and efficiently-produced products, such as triploid oyster seed, is likely to increase due to greater world-wide demand for these high-value products, together with improved technology. Transfer of live molluscs is driven by need and availability, with concern over infectious disease risks often playing a subordinate role or serving to support economic trade barriers. Experience shows that serious risks from infectious disease transfer exist. Technology and balanced management, however, can limit such risks. Separation of biological risks from trade control objectives is a necessary first step. A systematic method of risk analysis is urgently needed, along with predefined actions which can be adapted to the various risk levels. Critical to the effective development and implementation of this risk analysis is the participation of the shellfish industry in defining risks and actions. Organization and infrastructure to improve recognition of infectious diseases and decrease response time are necessary improvements, together with appropriately-targeted research on impacts, diagnosis, epidemiology, carrier status, and the geographical distribution of diseases.


INTRODUCTION

The trade of live molluscs includes edible adult life stages, as well as larval and seed molluscs. Gastropods such as abalone (Haliotis spp.) and bivalves such as oysters (Ostreidae), clams (Veneridae, Myidae), scallops (Pectinidae) and mussels (Mytilidae, Unionacea) are commonly-traded species groups. Molluscs may be a high-value product in many markets, stimulating interest in the development of new technology for the intensive cultivation of these species to supply growing markets. As the world demand for farmed seafood increases (to an estimated 77 million tonnes by the year 2025 [5]), a growth in world trade can be expected. Forces driving this trade, in addition to increasing demand, include local failures of production for various reasons, and the inability to supply a product which is safe for human consumption in other regions.

This paper will address trade in live molluscs from the perspective of the Americas. There are some governmental sources of information regarding imports and exports;
these focus on market-ready products rather than larvae and seed, and only limited information is available from some countries. Information on larval and seed transfer used in this paper was obtained directly by interviewing key producers.

TECHNOLOGY DEVELOPMENT AND SEED TRADE

Modern development of the technology for intensive hatchery production of larvae and seed molluscs was initiated in Britain in the late 1950s (6). This technology developed during the 1960s, but it was not until the mid-1970s that the North American industry became dependent on hatchery-reared larvae and seed. Health management of seed production was not addressed in a systematic manner until the 1980s (1). This development was a result of the declining availability of wild catch seed and the development of hatchery technology to the point that this method of production was commercially feasible. Subsequently, in North America, seed production for the Pacific oyster (*Crassostrea* sp.) has become highly sophisticated and efficient. Further developments have made triploid seed of the Pacific oyster and Manila clams (*Tapes philippinarum*) commercially available. Cost of larvae and seed from North American sources (figures for 1995) is approximately US$100 per million (oyster larvae) and US$5.50 per thousand (6-8 mm Manila clam seed), respectively. As a result, larvae and seed are sought by producers on several continents. One of the primary forces behind international transport of bivalve seed is the failure of local stocks, for various reasons, resulting in insufficient local supply of seed. If no local supply exists, bringing local seed production in line with demand may require a substantial investment over several years, and the initial result may be inferior quality seed. Purchase of remotely-produced seed is therefore a desirable solution in many cases.

Oyster larvae are sold at a stage where the foot is fully developed and the eye spots are prominent. This is the life stage which occurs immediately prior to metamorphosis, and the purchasers of such larvae will distribute these to a setting tank containing ‘culitch’ (material to which setting oysters attach), where they undergo metamorphosis and attach to the shell. Several million larvae can be concentrated to a mass of just a few centimetres in diameter and are viable for up to five days if refrigerated, thus facilitating their shipment anywhere in the world. Seed bivalves are sold at dimensions ranging from a shell height of 1-2 mm up to several centimetres. Species known to be traded in this fashion include oysters, clams and mussels (Table I).

Records may be kept by individual governments on larval and seed importations and exports, but there is no readily-available comprehensive source regarding the size and value of trade in mollusc larvae and seed. Single growers report export quantities of up to 400 million seed per year from North America.

TRADE IN LIVE EDIBLE MOLLUSCS

Live edible molluscs are a relatively high-value product which can be shipped economically between continents. Many species are traded, the most common being abalones, oysters, scallops, clams and mussels (Table II). At the receiving location, molluscs may be held in seawater tanks or shipped directly to seafood markets. As a
result, if the molluscs carry infectious diseases, there is a risk that such diseases will be disseminated at the recipient location either by release into marine waters or by release of seawater used for maintenance of the molluscs.

**INDUSTRY DEVELOPMENT AND TRENDS**

Growth in global seafood demand will continue to increase demand for molluscs, many of which are high-value products. In view of the dependence of the developing industry on seed production, an increase can be expected in global transfers of both

**TABLE I**

*Examples of intercontinental trade in mollusc seed to and from the Americas*

<table>
<thead>
<tr>
<th>Mollusc species</th>
<th>Life stage</th>
<th>Continents and direction of trade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastropods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Haliotis</em> spp. (abalone)</td>
<td>Seed *</td>
<td>Western North America to western South America and East Asia</td>
</tr>
<tr>
<td><strong>Bivalves</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Crassostrea gigas</em> (oysters)</td>
<td>Larvae **</td>
<td>Western North America to South America, East Asia, South-East Asia, Africa and Europe; Australia to western North America ***</td>
</tr>
<tr>
<td><em>Ostrea</em> spp.</td>
<td></td>
<td>Western North America to Europe; South America to North America and Europe</td>
</tr>
<tr>
<td><em>Tapes</em> sp. (Manila clams)</td>
<td>Seed *</td>
<td>Western North America to South America, Asia and Europe</td>
</tr>
<tr>
<td><em>Mytilus</em> spp. (mussels)</td>
<td>Seed *</td>
<td>Western North America to South America</td>
</tr>
</tbody>
</table>

* post-metamorphic life stages
** pre-metamorphic, water-column suspended life stages (usually eyed larvae in the case of oysters)
*** single importation reported to California in 1994

**TABLE II**

*Examples of intercontinental trade in edible live molluscs to and from the Americas*

<table>
<thead>
<tr>
<th>Mollusc species</th>
<th>Continents and direction of trade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastropods</strong></td>
<td></td>
</tr>
<tr>
<td><em>Haliotis</em> spp. (abalone)</td>
<td>South America to Asia, North America to Asia</td>
</tr>
<tr>
<td><strong>Bivalves</strong></td>
<td></td>
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<td><em>Crassostrea gigas</em> (oysters)</td>
<td>Western North America to Asia</td>
</tr>
<tr>
<td><em>Ostrea</em> spp.</td>
<td>Western North America to Europe; South America to North America and Europe</td>
</tr>
<tr>
<td><em>Tapes</em> sp. (Manila clams)</td>
<td>Western North America to Asia and Europe</td>
</tr>
<tr>
<td><em>Argopecten</em> spp. (bay scallops)</td>
<td>South America to North America, Europe and Asia</td>
</tr>
</tbody>
</table>
mollusc seed and market-ready edible products. Such transfers inevitably increase the risk of infectious disease transfer, but this risk can be managed and minimized.

Currently, North American and South American producers of edible shellfish sell product to continents which have major world markets (Asia, North America and Europe) as well as other locations. Animal health certification requirements vary widely and clearly influence the volume of trade, as they either add to the cost of trade or explicitly forbid trade.

INTERNATIONAL TRADE AND HEALTH ISSUES IN MOLLUSCS

Factors which drive commercial markets for molluscs

Importation of molluscs is driven first by need, second by availability, and third, subordinate to these factors, by the risk of infectious disease transfer. For example, the collapse of the French flat oyster set in the 1970s led to the wholesale and uncritical importation of Bonamia-infected oyster seed, even though the scientific literature had described the disease at the source location several years earlier (2). After the resultant collapse of the flat oyster industry in Europe, French producers imported large quantities of Pacific oyster seed, which forms the basis of the current industry. Similarly, the collapse of clam sets in the Venice lagoons necessitated importation of clam seed to maintain the industry.

When local supplies are adequate, it seems that more attention is paid to the risk of introducing diseases from outside sources, as there is limited need for importations. Such concern with potential importation of infectious diseases also serves to provide economic protection for the local production industry, particularly if the latter is less efficient than outside sources. The perception that infectious mollusc diseases have repeatedly originated in particular locations is sometimes used as an argument to bar trade from those regions. This essentially fallacious concept is used as a pretext to erect trade barriers. When need increases, however (e.g. due to local failures of production which cannot be countered by local producers), the infectious disease risk seems to subside, bureaucratic obstacles to importation become less complex, and thus trade increases.

These circumstances are partly the result of a combination of market forces and trade protectionism imposed in the name of infectious disease control. Such an approach may create several problems, both economic and biological. Whether or not there is an economic problem depends on the perspective one adopts. From a free-market point of view, all markets should be open so that consumers are offered products of the highest value. An alternative point of view is that governments or trading blocks should protect their domestic industries by erecting trade barriers, particularly if these are small developing industries. The primary point made here, however, is that by using infectious disease arguments to support what are essentially trade barriers, the beneficial effect of limiting the spread of infectious diseases is reduced and the implementation of disease control is thwarted.

Managing animal health risks

The movement of live animals and the attendant dissemination of disease is an inevitability, even without commercial trade. Clearly, there are many other avenues of
animal and disease dissemination besides commercial trade in seafood. Policies concerned with controlling animal diseases must be logical and practicable. 'Zero-risk' policies cannot be adopted. Failure of policies has often resulted from over-zealous attempts to control aquatic animal movements, the failure to recognize the multiple avenues of animal movements, and the lack of implementation of animal movement controls. It is important to identify the significant risks of animal disease transfer and to concentrate efforts on limiting such risks. Clearly-defined disease identification and impact criteria are also critically important in determining when actions need to be taken to control disease.

Need for systematic risk assessment and decision-making criteria

There are evident risks involved in moving live molluscs from one location to another; these animals should therefore not be moved before carefully considering such risks. When diseases are detected, the level of risk should be immediately and carefully determined, and appropriate action should be taken, even if this includes barring movements of shellfish. When historical surveillance and good management have indicated that there are no significant infectious disease risks, however, movements of live shellfish should be permitted. There is no systematic approach in use today to evaluate the risk of infectious shellfish diseases. Such an approach is needed and, when implemented, would ultimately result in greater protection of shellfish resources world-wide. The Office International des Epizooties has published the International Aquatic Animal Health Code (3) and the Diagnostic Manual for Aquatic Animal Diseases (4), in an attempt to address this need. This is an admirable beginning, but much work remains to be done with respect to the bivalve mollusc sections of these documents (in the present form, unilateral trade barriers are implied).

The elements of this risk assessment should include the following elements:

a) rate and means of transfer of the disease
b) species and life stages susceptible to the disease
c) geographic distribution of the disease
d) quantitative effect (mortality and morbidity) of the disease
e) relative economic impact of transferring or not transferring infected animals.

Management objectives should be limited to diseases causing a significant level of identifiable morbidity or mortality. Once numerical criteria for risk elements have been carefully defined, the management decisions that various levels of risk will trigger need to be determined. The shellfish industry must be fully involved in the process of defining risks and actions. Without such industry involvement, policies for shellfish disease control cannot be effectively implemented.

Management of shellfish diseases

Risk from shellfish movements can be reduced by the systematic practice of health management. This includes a historical record of shellfish diseases at source, procedures and practices to manage infectious diseases, and lot certification of shellfish. Process certification should replace lot certification wherever feasible. Once such a system of certification is in place, the certification must be officially sanctioned by the responsible and recognized government authority.
Response time when disease outbreaks occur

One of the key problems is the time required to mobilize a response to a disease outbreak. By the time new diseases are recognized, there may be little time to respond. The need to recognize disease outbreaks is basic to ensuring a rapid response. The solution therefore involves disseminating information on newly-emerging diseases, structured according to risk criteria. Given the extensive nature of most molluscan grow-out systems, high rates of mortality may be accepted by growers, and exceptional losses may not be recognized until months after they begin to occur. Losses in hatcheries and nurseries will be recognized more rapidly, but shellfish culturists must be educated and encouraged to adopt a proactive approach to disease outbreaks. Information on newly-emerging diseases is often best acquired from shellfish growers, but such information must be collected systematically. The collection and dissemination of this information by the shellfish industry, with some assistance from government, is very effective. Speed of response to outbreaks can therefore be optimized by obtaining better, more up-to-date information from shellfish growers regarding unexplained losses.

Negative economic impacts

Restrictions on transfers will cause short-term negative economic impacts. For disease control regulations to be effective, therefore, the shellfish industry must be involved – through representative trade associations or individual companies – in the definition of risk criteria and the determination of decisions resulting from each type of risk identification. Without such involvement, shellfish disease control cannot be effectively practised.

Need for research and development

More efficient diagnostic tools are needed, and more baseline information is needed on the distribution of diseases and the causes of mortality syndromes. The status of live shellfish as vectors of disease needs to be more fully understood. Research and development must be targeted more appropriately and made more cost-effective.

Standards for diagnosis and for shellfish health professionals

The Fish Health Section of the American Fisheries Society has published diagnostic standards for molluscan health certification. In view of the applied technology available, these standards are largely based on histological diagnosis. While histological methods will always be needed to some degree, standardized molecular and enzyme-based methodologies will soon be available. There is also a need to determine and develop qualification criteria for individuals and facilities conducting certification examinations of shellfish.

Résumé : Le commerce international de mollusques comestibles et de leur semence est particulièrement dynamique, notamment en ce qui concerne les huîtres, ormeaux, palourdes, coquilles Saint-Jacques et moules. L’offre de produits nouveaux obtenus par des méthodes performantes, tels que la semence d’huîtres triploïdes, est appelée à se développer en raison de l’accroissement de la demande mondiale pour ce type de produits de grande valeur et de l’amélioration des technologies. Les échanges de mollusques vivants dépendent de l’offre et de la demande ; les préoccupations liées aux risques de maladies infectieuses sont le plus souvent reléguées au second plan ou sont invoquées pour justifier l’application de barrières commerciales. Or l’expérience a montré que les risques de transmission de ces maladies infectieuses ne sont pas négligeables. Le recours à la technologie et une gestion rationnelle permettent toutefois de limiter ces risques. Il convient, dans un premier temps, de bien distinguer les risques biologiques des objectifs de contrôle commercial que l’on poursuit par ailleurs. Il faut d’urgence mettre en place une méthode systématique d’analyse des risques, et définir préalablement des mesures adaptées aux différents niveaux de risque. La participation de l’ensemble du secteur de la conchyliculture à la définition des risques et mesures correspondantes est indispensable à l’élaboration et à la mise en œuvre efficaces d’une telle analyse des risques. Une organisation et une infrastructure s’imposent pour améliorer l’identification des maladies infectieuses et réduire le délai de réaction. Il est également nécessaire de conduire des recherches concernant en particulier l’incidence de la maladie, son diagnostic, ses caractères épidémiologiques, ses réservoirs et sa répartition géographique.

MOTS-CLÉS : Commerce international – Continent américain – Contrôle des maladies – Mollusques – Santé.


Resumen: Existe en el mundo un activo comercio de moluscos, orientado tanto a la reproducción como al consumo de especies tales como ostras, orejas de mar, almejas, veneras y mejillones. Es probable que la mayor oferta de nuevos artículos de producción masiva (semen de ostras triploides, por ejemplo) obedezca, junto a los progresos tecnológicos, a la mayor demanda existente a nivel mundial de este tipo de productos de elevado valor. El tráfico de moluscos vivos está regido por la necesidad y la disponibilidad. En este contexto, la inquietud por el riesgo de transmisión de enfermedades infecciosas suele convertirse en una coartada para la implantación de aranceles aduaneros. No obstante, la experiencia demuestra que existe un serio riesgo de transmisión de enfermedades infecciosas. Una gestión equilibrada y el uso adecuado de la tecnología pueden, sin embargo, limitar tal riesgo. La clara diferenciación entre los riesgos biológicos y los objetivos de control comercial constituye un primer paso imprescindible en tal dirección. Es urgente establecer un método sistemático de análisis de riesgos, junto a un conjunto de medidas predefinidas.
en función del grado de riesgo. La participación de la industria marisquera en la definición de los riesgos y de las medidas a tomar resulta esencial para un desarrollo e implantación efectivos del análisis de riesgos en este campo. Es necesario asimismo dotarse de una organización e infraestructura adecuadas para la detección de las enfermedades infecciosas, la reducción del tiempo de respuesta y el desarrollo de actividades de investigación con un objetivo claro y específico sobre el impacto, diagnóstico, epidemiología, estado portador y distribución geográfica de las enfermedades.


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REFERENCES