

RISK ASSESSMENT FOR FARMED SPINY LOBSTER – *Panulirus species*

Note that *Panulirus ornatus* and *Panulirus homarus* are the only two spiny lobster species being developed for aquaculture, and the FAO production statistics do not differentiate between the two. Generally speaking, *P. ornatus* is the main cultivated species in Vietnam, with a developing aquaculture industry for *P. homarus* in Indonesia. Production of *P. ornatus* accounts for ~80% of farmed spiny lobster, and in 2016 was estimated to be about 1600 tonnes, worth more than US\$120 million (Jones, 2018).

Panulirus ornatus, known as the flower or ornate spiny lobster, is a tropical lobster native to the Indo-Pacific region that has become a popular aquaculture species in recent decades. A surge in demand for these brightly colored crustaceans came in the 1980s from China as the middle class began expanding, and led to the farming systems that now exist in several Southeast Asian countries. *P. ornatus* is currently farm-raised in Vietnam, Indonesia, Philippines and Malaysia, although only in Vietnam is the industry large and stable.

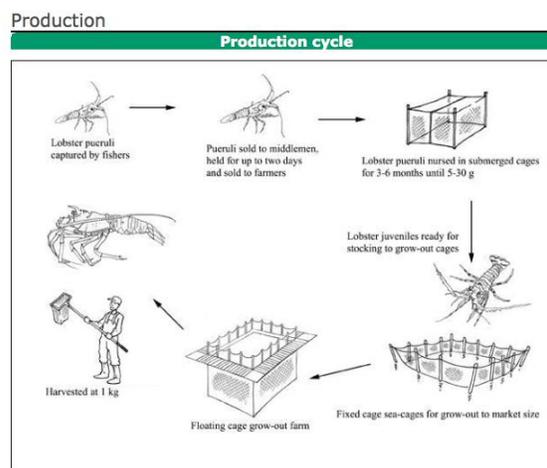
Panulirus homarus, known as the scalloped spiny lobster, is also native to the Indo-Pacific region, with similar ecology to *P. ornatus*, though *P. homarus* is a smaller species. Farming of *P. homarus* is currently being expanded in Indonesia with support from Australian aquaculture research.

Aquaculture of both species is **entirely dependent upon wild caught juveniles** as hatchery technology has not reached commercialization scale due to the lobster's lengthy larvae stage. According to the FAO, approximately 2,010 tonnes of *Panulirus spp* were produced in 2017, nearly 75% of which came from Vietnam.

→ Species		Tropical spiny lobsters nei [Panulirus spp]														
→ Measure		Tonne														
→ Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017		
→ Country		Unit														
Non-OECD Economies	Indonesia	Tonnes	..	..	..	292	339	311	225	488	914	202	161	218	(E)	500
	Malaysia	Tonnes	..	..	..	..	..	..	..	..	..	10	10	..	..	2
	Philippines	Tonnes	19	23	64	72	64	89	68	38	13	10	9	10	..	12
	Viet Nam	Tonnes	..	..	..	720	1 003	631	742	803	705	1 341	1 383	1 389	..	1 480

(Source: https://stats.oecd.org/Index.aspx?DataSetCode=FISH_AQUA#)

In Vietnam, the wild fishery for large *Panulirus ornatus* began to experience declines in the 1990s due to overfishing, so fishermen turned to catching smaller lobsters and fattening them in pens, a process known as ranching. Lobsters are primarily caught at the puerulus stage (plural pueruli), a post larval stage during which they do not feed and actively swim toward the coast to settle. Pueruli resemble the adult lobster in body form but are not referred to as juveniles until after the first molt. As the lobster farming industry continues to expand, there are concerns regarding sustainability of seed supply, feed source, disease



and pollution. At present there is no hatchery supply for *Panulirus ornatus*, nor is formulated pellet feed widely available.

The diagram on the previous page shows the typical production cycle for lobster farming in Asia (Source: http://www.fao.org/fishery/culturedspecies/Panulirus_homarus/en).

Vietnam

Vietnam boasts the most well established and productive tropical lobster aquaculture industry in the world. When the wild capture fishery began declining, with decreasing catch and size, Vietnamese fishers began holding on to the smaller lobsters until they reached a larger size and were ready for market. Since 1996, the majority of spiny lobster coming from Vietnam “have been farmed from an initial capture size of less than 5 g.” (FAO 2011-2020). A large proportion of the farmed lobster produced by Vietnam is supplied to the live seafood markets of Hong Kong, where there is local consumption and transshipping to Shanghai and Beijing in mainland China. *P. ornatus* is most valued as a large lobster, over 1 kg, served uncooked, sashimi style as a center piece for formal banquets. Most farms are small to medium sized enterprises involving one or two extended families. They sell to consolidators who pack and ship the live lobsters to Hong Kong and China.

Lobster farming methods have not changed much since development in the 1990s. Grow out facilities include cages originally built in shallow water with netting and wooden stakes secured into the seafloor; most are now a floating design moored to the bottom, made with re-used plastic drums and timber, exhibiting square cross section cages that together create a framework of numerous cages. The industry supports several livelihoods therein, including seed fishers, middleman dealers, and farmers. Though disease is a constant threat to the industry, lobster farming has proven extremely lucrative for all involved, with thousands of livelihoods in poor coastal communities supported, and sustained from demand from China far exceeding supply.



Figure 1 (credit: Jones, 2015)

Risk Assessment

- **Farm Siting: Medium Risk**
 - Planning laws exist but are not fully enforced/only partially effective.
 - Article 28 of the Fisheries Law outlines allocation and lease of marine areas for aquaculture; Article 29 includes conditions for revoking leases/allocations of aquaculture areas.
 - Although permits are required, the Law allows for “families engaged in small scale aquaculture do not need permission to exploit and use sources of surface water, underground water, or sea water (for raising marine products).” (Access to Water, FAO 2011-2020).
 - Environmental Impact Assessment (EIA) reports are required for all projects that:
 - use land or water areas of national parks, conservation zones, biosphere reserves, and national heritage areas;
 - cut forest or mangrove forest with total area over 20 ha, or cut natural forest with total area over 200 ha;
 - sandy soil aquaculture projects with total area of 100 ha;
 - all projects with potential to cause adverse impacts to water sources;
 - extensive aquaculture projects with surface areas 50 ha and greater
 - all other sandy soil aquaculture projects (p.261 FAO, 2009)
 - All remaining aquaculture and household farms do not require a full EIA, rather a “Commitment of Environmental Protection” must be made.
 - Concerns such as cage density, current flow, and proximity to other farms are up to the individual farmer.

- **Nutrient Pollution: Medium Risk**
 - There is some monitoring of water quality and feed use, though not to any prescribed standard; monitoring records are incomplete.
 - Feed is a large source of pollution in the lobster farming environment; the organic material causes excess nitrogen and poor water quality.

- **Feed Source: High Risk**
 - The source of feed comes from an unsustainable fishery.
 - It is common practice for lobster farms in Vietnam to use cheap, unidentified fish species that are considered “trash fish” at the market, unfit for human consumption or undesired and accidentally caught as bycatch. Not only is bycatch unsustainable, but so is the vast quantities of marine protein used as food for lobster: the inputs (feed) are greater than the outputs (lobster).
 - As noted by the FAO, “Feed conversion ratios for trash fish fed to lobsters range from 25 to 50:1. Thus 25-50 kg of food enters the farm environment for every kilogram of lobster produced.” (FAO 2011-2020).
 - “The condition of the fish when applied to the lobster cages is often poor, and over time this diet is deficient in essential nutrients,” (p.85, Jones 2015).
 - Further, this type of feed has a negative effect on the environment in which the lobsters are raised, contributing to unsanitary conditions and disease.

- Effective formulations for a compound diet have been prepared but not yet adopted. In Vietnam this will require a transition, while in Indonesia the industry will develop with manufactured feeds.
- Disease, medicine, chemicals: High Risk
 - The farm can evidence that medicines and chemicals are legal, though records are incomplete.
 - Disease is a major problem in the lobster aquaculture industry of Vietnam, due to high density, pollution created by feed, and poor nutrition from feed.
 - A number of diseases affect lobster farms in Vietnam and between 2007-2009, “Approximately 50% of total production was lost due to milky disease,” which significantly reduced survival through the grow-out stage (p. 85, Jones 2015).
 - Antibiotics are the standard treatment for disease; one study found that 82% of the Vietnamese lobster farmers surveyed used antibiotics (Hedberg et al, 2018).
 - Considering lobster grow-out facilities are not self-contained, these medicines also have an effect on the surrounding environment.
- Introductions, genetics: Low Risk
 - The farm operation does not pose a risk to native species/populations as the species is already native to the country, and farmed species genetics are identical to the wild.
 - Considering the species is native to the region and local, wild caught juveniles are ranched in order to increase size for market, there is essentially no risk associated with escapes.
- Wild seed: Medium Risk
 - The operation relies on wild seed collection, which may have an impact on wild populations of the species.
 - No hatchery supply exists for lobster.
 - FAO notes that seed supply in Vietnam is fully exploited, however, there is no indication that this is unsustainable. The wild fishery for large lobsters was in a state of collapse before the harvest of seed began. Seed availability and catch have remained constant (3 to 5 million seed per year) for the past 15 years, with no change in local adult abundance.
 - Several areas along the Vietnamese coastline are identified as key lobster seed catching locations; farmers may catch their own juveniles but many also need to purchase from other regions of the country.
 - Vietnam imports millions of lobster fry each year, primarily from Indonesia and the Philippines. Indonesia has now revised its policy and regulations to allow seed fishing and some export. As such, the seed fishery in Indonesia will be a managed resource.
- Fish Welfare: Medium Risk
 - Aspects of animal husbandry not properly controlled (stocking densities not recorded/managed, no veterinary care plan).

- The issues with disease, medicine, stocking density, and nutrient pollution through feed are concerning from a welfare standpoint.
- Majority of lobster is sold and transported live, slaughter techniques are not a concern on the farm.

Indonesia

Lobster aquaculture began in Indonesia in the early 2000s, after the 2004 tsunami, in the southeast region of Lombok. Six species of lobster are caught as seed and ranched, following the lobster farming techniques of Vietnam: the primary species farmed here is *Panulirus homarus*, followed by *Panulirus ornatus*. Lobster aquaculture was very small up to 2015 and then reduced to nothing due to the regulations imposed. In 2020, revised regulations are allowing lobster aquaculture to restart, but production to June 2020 has been less than 50 tonnes (Jones 2020). The industry is still in a developmental stage, but production has steadily increased over the past several years, as has its geographic footprint. Australia has assisted in spreading lobster farming knowledge and practices to coastal communities, and the Indonesian government fully supports expansion. As the industry develops, it may be kept at a sustainable level with proper regulations in place.

Risk Assessment

- **Farm Siting: Medium Risk**
 - Planning laws are in place, although they don't completely mitigate all risks concerned with farm siting.
 - A specific license is required to engage in aquaculture, which must be issued by the Provincial Governor, however, "small fishermen and small fish breeders are exempt from such requirements," (FAO 2005-2020). The Provincial Governor is also responsible for identifying coastal areas for mariculture in their territory.
 - For shrimp cultivation or fish-breeding ponds exceeding 50 ha in size, an EIA (environmental impact assessment) is required.
- **Nutrient Pollution: Medium Risk**
 - Farming of spiny lobster in Indonesia is at an early stage of development compared with Vietnam.
 - There will be a government led industry development program, requiring and supporting sustainable practices. Australia will again be involved in providing support to achieve this.
- **Feed Source: Medium Risk**
 - The source of feed may come from an unsustainable fishery.
 - Feed has traditionally come from low value finfish, caught by the farmer. This strategy is an inefficient use of energy with much higher input of protein than output.
 - However, new policy developments in Indonesia with support by Australia will focus on the commercialisation of manufactured feeds and a requirement that they be used rather than fresh seafood. Under the new policy in Indonesia, a government

led industry development program is in place requiring and supporting sustainable practices.

- Disease, medicine, chemicals: Medium Risk
 - The farm can evidence that medicines and chemicals are legal, although records are incomplete.
 - Milky disease has been confirmed in lobster farms in Indonesia. However, the industry is still small and developing so transmission is not as high as in other countries.
 - Antibiotics are used to treat disease.
 - The Fisheries Law indicates “the use of chemical or biological substances which may harm aquatic resources or the environment is forbidden in both fisheries and aquaculture,” and prohibits additives that may endanger human health (FAO 2005-2020).

- Introductions, genetics: Low Risk
 - The farm operation does not pose a risk to native species/populations as the species is already native to the country, and farmed species genetics are identical to the wild.
 - Considering the species is native to the region and local, wild caught juveniles are ranched in order to increase size for market, there is essentially no risk associated with escapes.

- Wild seed: Medium Risk
 - The operation relies on wild seed collection, although the wild population(s) of the species is not threatened with overexploitation.
 - No hatchery supply exists for lobster.
 - Several hotspots have been identified around the country as supplying a significant amount of lobster seed; the industry is still underdeveloped in Indonesia and there remains room for growth.

- Fish Welfare: Medium Risk
 - Aspects of animal husbandry not properly controlled (stocking densities not recorded/managed, no veterinary care plan).
 - Because the industry is still young, participants are using the least costly materials and methods; for example, pueruli are transported in water bottles without aeration and there are no guidelines on stocking density.

Philippines

A small amount of lobster farming takes place in the Philippines where it is largely undertaken on a subsistence scale. Recently the government announced an initiative to bring knowledge and materials for lobster farming to poor coastal communities as a poverty reduction tool (Meniano, 2018). In 2018, a substantial wild seed resource has been confirmed along the east coast of the Philippines through a USDA funded project delivered by Winrock International. The resource has not been quantified, but is sufficient to support a large-scale lobster farming industry. However, farmer capacity is low. The Philippines government recently announced a National Lobster Development Plan to provide a framework and resources to support development of a sustainable industry. The Philippines can be considered to be one to two years behind Indonesia, with similar potential.

Malaysia

Five species of *Panulirus* make up the lobster fishery in Malaysia, with *P. ornatus* the most sought after due to its high price in the export market. Lobster aquaculture has not caught on in Malaysia as it has in the other countries noted, instead developing with investment. Completed in 2014, the Integrated Lobster Aquaculture Park is a joint venture between Darden, Ever Nexus, and Yayasan Sabah, located in Sabah, East Malaysia. Specifically developed for *P. ornatus*, the facility was intended to act as a hatchery as well as a grow out facility, taking the lobster from larvae to market size. However, as of 2015 there was no production from the facility as the initiative has stalled following the exit of the primary investor Darden. Current evidence suggests there is no lobster production and no local seed resource.

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