Aquaculture

Crustaceans for food and profit

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Taxonomy

- Phylum: **Arthropoda** (Latreille, 1829)
- Subphylum: **Crustacea** (Brünnich 1872)
- Class: **Malacostraca** (Latreille, 1802)
- Order: **Decapoda** (Latreille, 1802) – “ten footed” crustaceans

- Order Decapoda – nearly 15,000 species in around 2,700 genera, with approximately 3,300 fossil species
- Most variable group in the Phylum Arthropoda

Origin and distribution

- Oldest known decapodans – The Devonian (period of Paleozoic Era) 420 mya
- Saltwater
- Freshwater
- Semi-terrestrial
- Worldwide distribution (including rivers, brooks, swamps, oceans, warm as well as cold seas, tidal zone, rainforests, caves, ephemeral waterbodies…)

Main groups of farmed and trapped ten footed crustaceans

- **Shrimps**
  - Freshwater, saltwater
  - Farmed, trapped

- **Crayfish**
  - Freshwater
  - Farmed, trapped

- **Crabs**
  - Freshwater, saltwater, semi-terrestrial
  - Farmed, trapped

- **Prawns**
  - Saltwater
  - Farmed, trapped

- **Slipper lobster**
  - Saltwater

- **Clawed lobsters**
  - Freshwater, saltwater, semi-terrestrial

- **Spiny lobsters**
  - Saltwater

- **Hermit crabs**
  - Freshwater, saltwater, semi-terrestrial
  - Trapped
Farming and hunting purposes

- Consumption – delicacy, non-fat meat
- Pet trade
- Fish bait
- Research (biology, ethology, ecology, genetics…)
- Ornamental fish feeding
- Chitin (pharmacology, cosmetics, industry…)
- Safe breedings

Complications for farmers

- Burrowing – damage of pond dikes
- Cannibalism and territoriality
- Infectious diseases in intensive breedings – rapid spread in a short period of time
- Escapes and releasing – invasiveness of non-indigenous species
- Legislation – locally banned farming of non-indigenous species; restriction of pollution from farms…
- Predators – fish, herons, kingfishers, ducks, cormorants, otters, minks, water rats, foxes, monkeys, dogs, cats, racoons, platypuses, crocodiles, cephalopods, whales, frogs, snakes, turtles, ants, dragonfly larvae…

Methods of farming

- **Extensive systems**
  - Large ponds
  - Low abundance
  - Low costs
  - Low production

- **Semi-intensive systems**
  - Smaller ponds than in extensive sys.
  - Lower abundance than in intensive sys.
  - Compromise costs/profit

- **Intensive systems**
  - Smallest ponds, drains or tanks
  - High abundance
  - High costs
  - High production and profit

Artificial incubation

- Fertilized eggs are incubated in Zug bottles (volume of 10 l) with aeration – risk of fungi infection
- Larvae development in saltwater:
  - Hatched larvae (zoea) placed in salinity 34–35 ‰ (saltwater); feeding with algae and cyanobacteria; power filtration
  - Larvae in benthic stage placed in water with salinity 17 ‰, after 7 days in 10 ‰, after 7 days in 5 ‰, after 7 days in freshwater
  - Nevertheless, the mortality can be high (near to 90%)
Shrimps - farming

• Farming had started in China in 8th century BCE
• Tambaks – traditional small-scale farms with brackish water in Indonesia (15th century CE)
• First large-scale farming in 1930, expansion in 1960-70
• Leading producers (farming and trapping): China, Thailand, Indonesia, India (in Europe: Norway)
• Main importers: Japan, USA, West Europe
• Small ponds with size of 1 ha or less
• Farm increasing – destruction of mangrove forest ecosystem and deterioration in water quality

Large-scale shrimp farm

• Modern technologies = higher production
• Higher pressure and impact on landscape (salinization)
**Gold Coast Marine Aquaculture (Australia 45 ha)**

- Modern hatchery
  - Indoor tanks
  - Monitored water inlet and quality, feeding, health, growth rate...
  - Harvesting of adults 3 times per year

**Flowchart**

- Broodstock
- Berried females obtained from captive broodstock
- Larvae obtained from egg-carrying (berried) females
- Larvae raised through 11 larval stages to metamorphosis in ponds
- Captured larvae in hatchery tanks (16-31 days)
- Postlarvae into nursery tanks or earthen nursery ponds
- Flow-through or recirculation systems used
- Released juveniles
- Pond aeration
1982 – average production 582 kg/ha/year
1999 – average production 2300 kg/ha/year
Trapping
- Shrimps and prawns which are abundant
- Species which do not reproduce in captivity
- Traditional capture vs. modern ships (cages, trawl nets)

Bycatch
- Shrimps and prawns: 10–30% of total catch only!
- Killing of many saltwater animals
- WWF – legislative restrictions

TTED
- Trash and Turtle Excluder Device
  - more than 90% of bycatch survive
- Mandatory from January 2010

Exploited shrimps and prawns
Penaeus vannamei
- Saltwater prawn
- Production 1,116,000 tonnes per year
- 23 cm TL

Penaeus monodon
- Saltwater prawn
- Production 770,000 tonnes per year
- 33 cm TL

Acetes japonicus
- Saltwater prawn
- 30 mm TL
- Capture: >500,000 tonnes per year

Macrobrachium rosenbergii
- Shrimp
- Larvae in saltwater, adults in freshwater
- 50,000 eggs 5 times per year
- Production 280,000 tonnes per year
- 32 cm TL
Ornamental shrimps

- Small-sized
- Attractive coloured
- Special colour patterns and morphs
- Freshwater, saltwater

Crayfish

- Strictly freshwater (only one exception is Astacus pachypus)

Crayfish - farming

- Leading producer: China (replaced USA) (in Europe: Sweden, Spain)
- Crayfish plague – risk of escape of non-indigenous species
- Shallow ponds with many shelters or indoor tanks
- Rotation of crayfish farming and rice or soya cultivation
Grow-out pond with nets against water birds

Pond aeration

Production of crayfish

Globally increasing year by year – near to 900,000 tonnes per year worldwide in 2012
Most commercially attractive species – *Procambarus clarkii*

Commercially farmed crayfish

*Procambarus clarkii*

- Vector of crayfish plague
- Very adaptable species – high invasiveness

*Procambarus acutus*

Species complex?
Vectors of crayfish plague

*Procambarus zonangulus*
**Cherax quadricarinatus**
- Sensitive to crayfish plague
- High invasiveness

**Cherax destructor**
- Sensitive to crayfish plague
- High invasiveness

**Cherax cainii**
- Outdated name *C. tenuimanus*
- Sensitive to crayfish plague

**Pacifastacus leniusculus**
- Vector of crayfish plague
- High invasiveness
**Astacus astacus**

- Protected by law in EU countries
- Sensitive to crayfish plague

**Ornamental crayfish**

- Reproduction in indoor home tanks
- Attractive coloured morphs – preferred
- Illegal releasing in the wild

**Trapping**

- Local legislative restrictions
- Digging from holes, cages, wicket traps, rake frames…

**Crabs**
Crabs - farming
- Ponds, cages, indoor tanks
- Most of species of crabs need saltwater
- Rotation of crab farming and rice cultivation

Cages - inhibition of cannibalism
- Farms in mangroves
Globally production of crabs

Rapid increasing trend – 1,500,000 tonnes of crabs in 2012

Soft-shell crabs

- Harvest up to one hour after moult
- Monitored in 4 hour period
- Soft carapace - attractive for consumption
- High price

Bizzare vending machine

Commercially farmed crabs
**Eriocheir sinensis**

- Larvae – saltwater
- Adults – freshwater

**Portunus trituberculatus**

- Saltwater
- Most trapped crab worldwide
- Modern hunting technologies totally inhibited farming of this species

**Scylla serrata**

- Saltwater
- Up to weight 3 kg
- 6,000,000 eggs

**Trapping**
Ships with baited cages

Laying the traps

The crab boat may lay several configurations of baited cages throughout an area

Lobsters

- Spiny lobster
- Clawed lobster

Spiny lobsters

- Saltwater
- Mostly captured
- Production from farming declining:
  - 1990 – 90 tonnes, 2005 – 30 tonnes
Clawed lobsters
- Saltwater
- Up to 126 cm TL, weight 19 kg
- Very aggressive and territorial
- Mostly trapped

Production from trapping of Homarus americanus

Slipper lobster
- Saltwater
- Not intensively trapped
- Not farmed
- Annual production is around 5,000 tonnes
- Usually caught by scuba divers

Hermit crabs
- Trapped only
- Low production
- Small species only as pets
- Saltwater, semi-terrestrial

Coconut crab (Birgus latro)
Thank you for your attention