2014

Aquaculture

Crustaceans for food and profit

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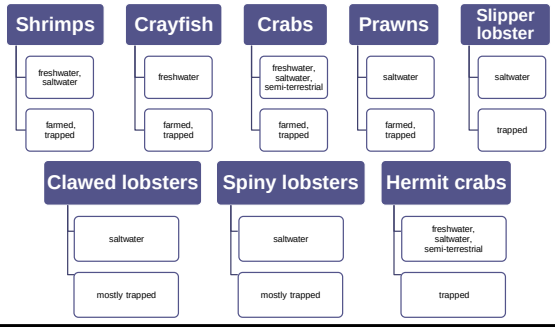
Taxonomy

- 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, tidel zone, rainforests, caves, ephemeral waterbodies…)

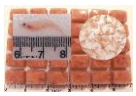
Main groups of farmed and trapped ten footed crustaceans



Farming and hunting purposes

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

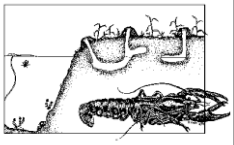




Complications for farmers

- Burrowing – damage of pond dikes
- Cannibalism and territoriality
- Infectious diseases in intensive breedings – rapid spread in a short period of time
- Escapes and releasing – invassiveness of non-indigenous species
- Migration and timing of reproduction
- 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… **HUMANS**




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

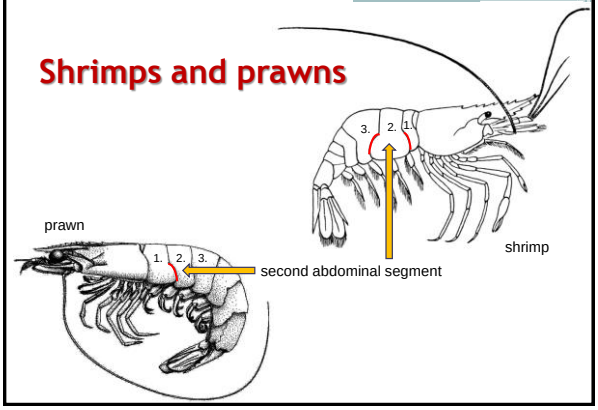

extensive farming

intensive farming


Artificial incubation

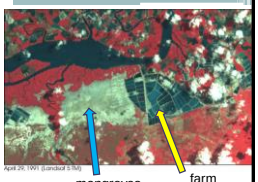
- Fertilized eggs are incubated in Zug bottles (volume of 10 l) with aeration – risk of fungi infection
- Larvae development in saltwater:
  - Hatched larvae (zoea) placed in salinity 34-35 ‰ (saltwater); feeding with algae and cyanobacteria; power filtration
  - Larvae in benthic stage placed in water 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 and prawns



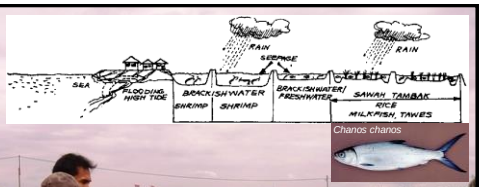
Shrimps – farming

- 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



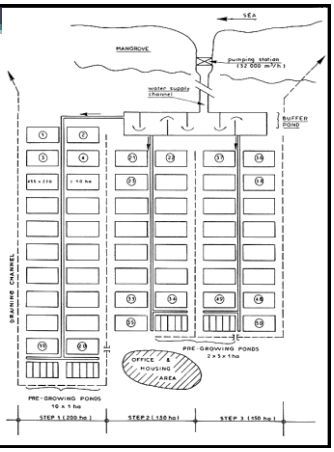
Ecuador

tambak



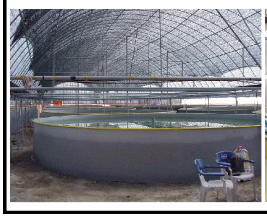
Large-scale shrimp farm

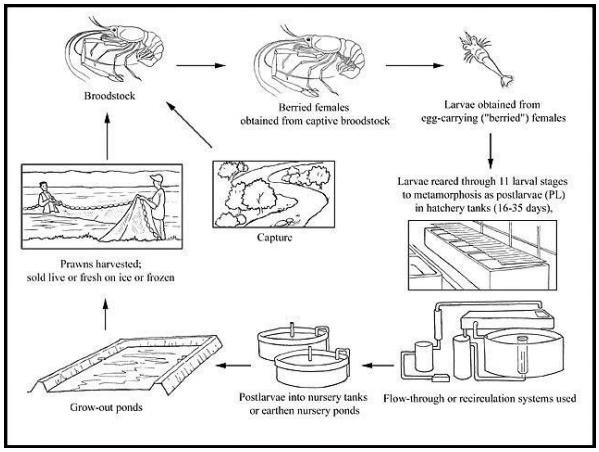
- Modern technoligies = higher production
- Higher pressure and impact on landscape (salinization)



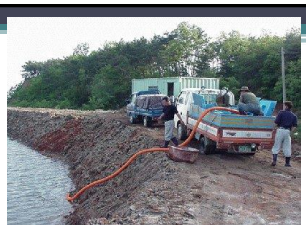
Modern hatchery

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

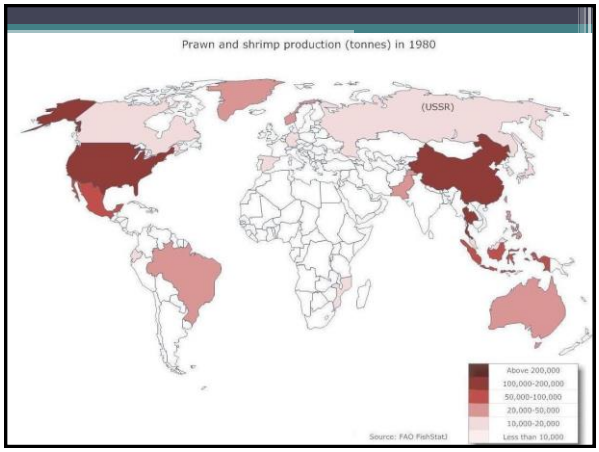


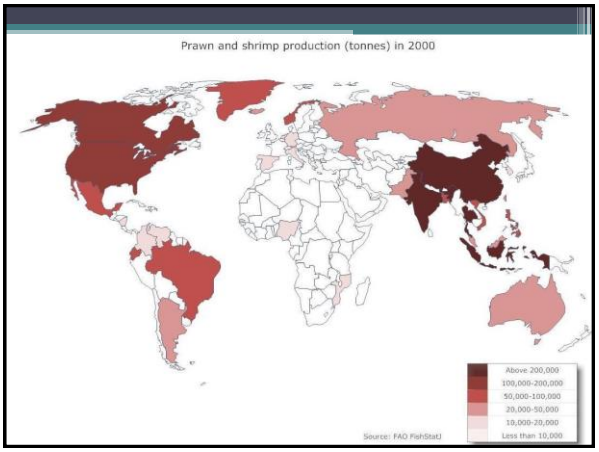


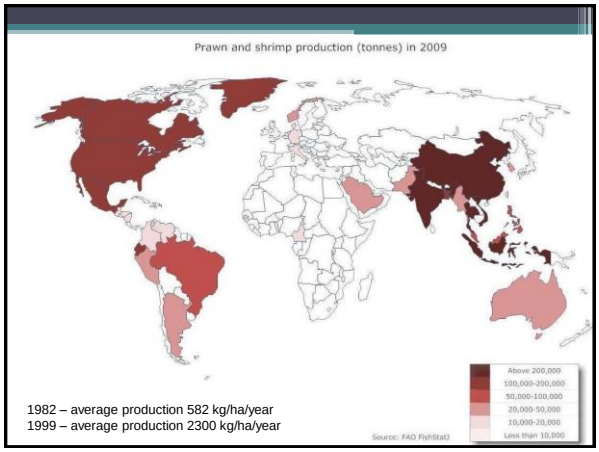
- Releasing of juveniles



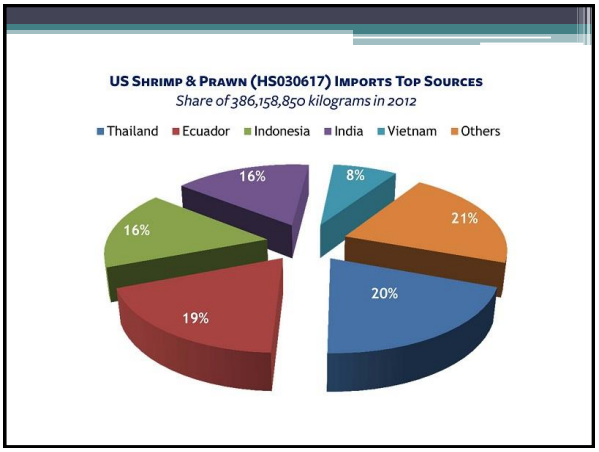
- Pond aeration







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)



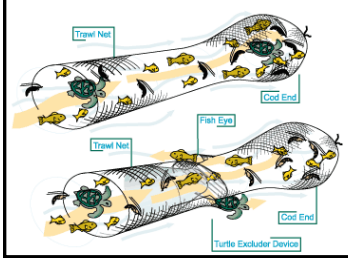

Bycatch

- 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

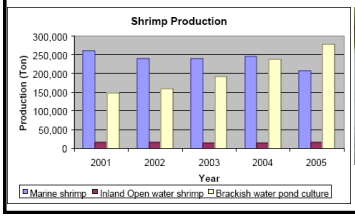
Exploited shrimps and prawns

Penaeus vannamei

- Saltwater prawn
- Production 1,116,000 tonnes per year
- 23 cm TL

Penaeus monodon

- Saltwater prawn
- Production 770,000 tonnnes per year
- 33 cm TL



Acetes japonicus

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

Macrobrachium rosenbergii

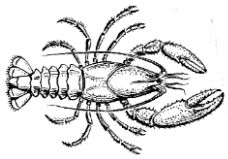
- Shrimp
- Larvae in saltwater, adults in freshwater
- 50,000 eggs 5 times per year
- Production 280,000 tonnes per year
- 32 cm TL

Ornamental shrimps

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

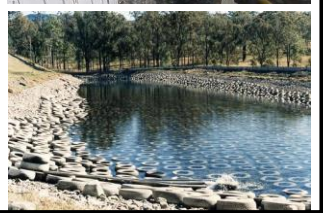
Crayfish

- Strictly freshwater (only one exception is *Astacus pachypus*)

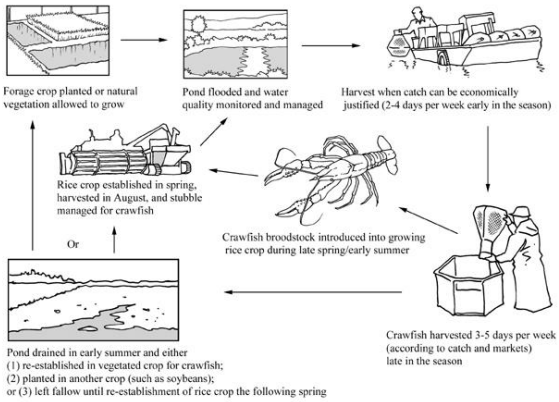


Crayfish - farming

- Leading producent: 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



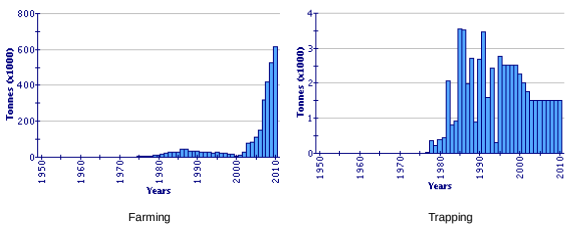
Pond aeration

Production of crayfish

Table 20.2 Production estimates for world freshwater crayfish in 2001

Region	Total production (t)	Aquaculture production (t)
USA	50 000	35 000
Canada	10 000	< 1000
Europe	5000	< 500
China	70 000	35 000
South-East Asia	1000	1000
Australia	1000	500
Central/South America	< 500	< 500
South Pacific Islands	< 500	< 500
Southern Africa	< 500	< 500
World total (approximate)	138 500	74 500

Globally increasing year by year – near to 900,000 tonnes per year worldwide in 2012



Farming Trapping

- 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

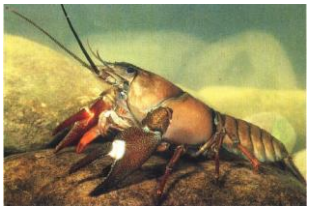
- Sensitive to crayfish plague
- High invasiveness

Cherax cainii

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

Pacifastacus leniusculus

- Vector of crayfish plague
- High invassiveness



Astacus astacus

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

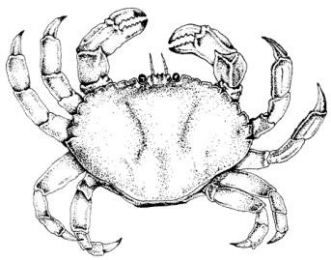
Ornamental crayfish

- Reproduction in indoor home tanks
- Attractive couloured morphs – preffered
- Illegal releasing in the wild

Trapping

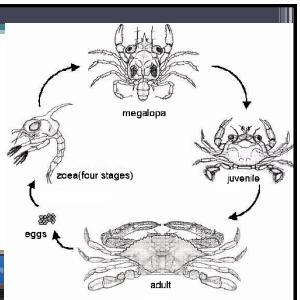
- Local legislative restrictions
- Digging from holes, cages, wicket traps, rake frames…

Crabs



Crabs - farming

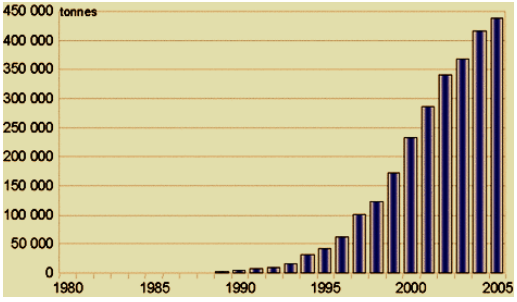
- Ponds, cages, indoor tanks
- Most of species of crabs need saltwater
- Rotation of crab farming and rice cultivation



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

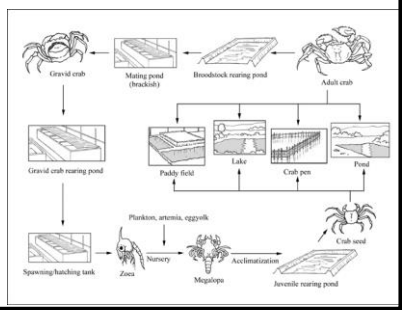
- Harvest up to one hour after moult
- Monitored in 4 hour period
- Soft carapace - attractive for consumption
- High price

Bizzare vending machine

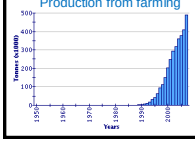
Commercially farmed crabs

Eriocheir sinensis

- Larvae – saltwater
- Adults – freshwater



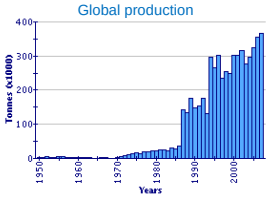
Production from farming



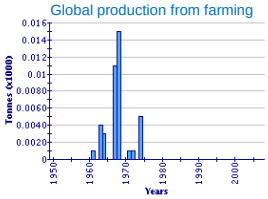
Portunus trituberculatus

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

Global production

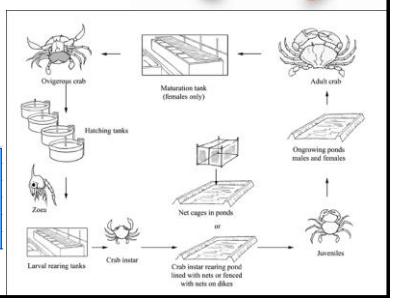


Global production from farming

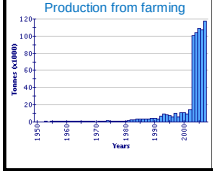


Scylla serrata

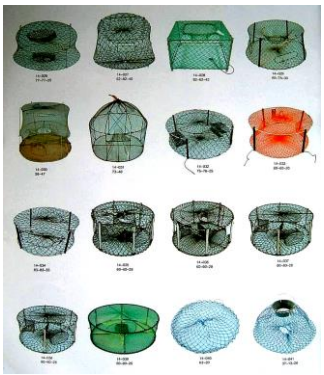
- Saltwater
- Up to weight 3 kg
- 6,000,000 eggs



Production from farming

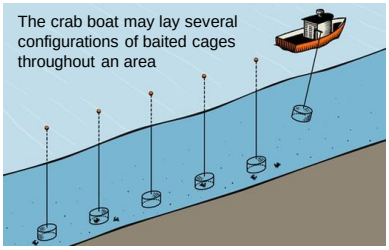


Trapping

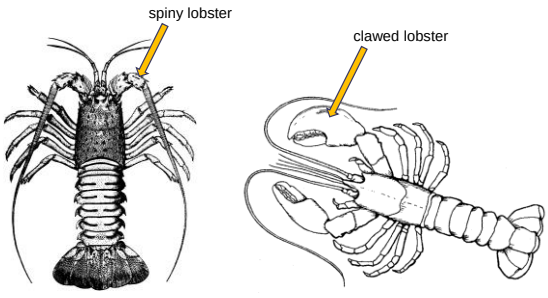


Ships with baited cages

Laying the traps



Lobsters



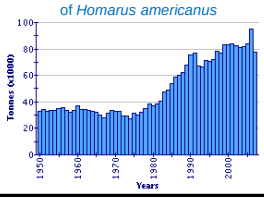
Spiny lobsters

- 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

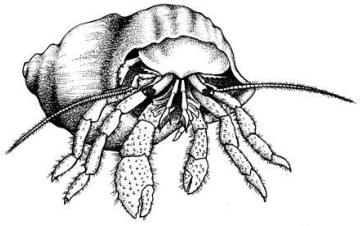
Production from trapping of *Homarus americanus*



Slipper lobster

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

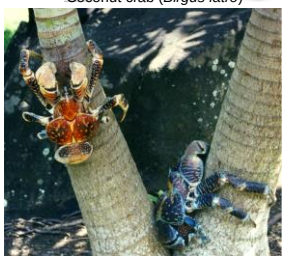
Hermit crabs



Hermit crabs

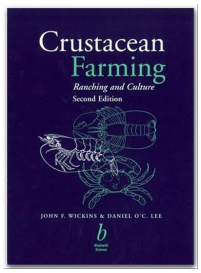
- Trapped only
- Low production
- Small species only as pets
- Saltwater, semi-terrestrial

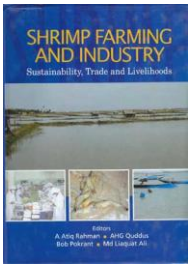
Coconut crab (*Birgus latro*)

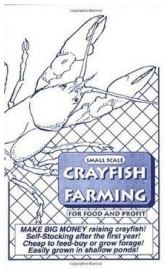


Paralithodes camtschatica

References







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