CRUSTACEANS

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Contents

Summary

Due to their particular aspect and secret behavior, Crustaceans are largely described in terms of classification, distribution, morphology, and physiology. Only the species

having a world importance for fishing and farming are considered. Before the information on the known ecology and the exploitation of each animal, some data are given on their enemies: competitors, diseases (mainly the plague by *Aphanomycosis*), and poisons (mainly the pesticides and other chemicals).

Among the crayfish, there were originally only five European species of which noble crayfish, *Astacus astacus*, and narrow-clawed crayfish or Turkish crayfish, *A. leptodactylus* are the most important ones. In addition there are nowadays two important introduced species, red swamp crayfish, *Procambarus clarkii*, and signal crayfish, *Pacifastacus leniusculus*. The total harvest in 1994 in Europe was 4250 metric tons. The net import of crayfish to Europe was 3100 metric tons in the same year.

There are more than 360 species of crayfish in North America of which red swamp crayfish, *Procambarus clarkii*, in southern USA is most important from the commercial point of view and species of the genus *Orconectes* in the middle and northern America are of less commercial importance. Total harvest of the former species in USA is around 50 000 metric tons.

In Australia there are three important commercial species, viz. yabby, *Cherax destructor*, red claw, *C. quadricarinatus*, marron, and *C. tenuimanus*. The total harvest was more than 300 metric tons in 1992/93.

In Asia the giant river prawn, *Macrobrachium rosenbergii*, dominated the harvest, which might be in the order of 70 000 metric tons. In addition to that the harvest of the introduced *Procambarus clarkii*, might be in the order of 40 000 metric tons.

Many crayfish species and prawns are cultivated nowadays. Semi-intensive methods in ponds are the most common method. There are, however, both extensive and intensive methods practiced. The latter mainly in basins and troughs.

Management of species exists in many countries. Rules and regulations are introduced for catches of wild animals, which include regulation of the fisheries with regard to time of the year, maximum catches, minimum size of caught specimens, minimum size of mesh size in traps, and measures to enhance the stock size.

To avoid spreading crayfish plague and other diseases special import regulations are implemented, and rules for the fishery.

Conclusion underlines the need of a large field of knowledge mainly to push both the economy, and the ecology of the crustaceans.

1. Introduction

Few crustaceans are suitable for farming. Since the systematics of these species are better known than their ecology, only those species with a long tradition of natural exploitation, according to empirical rules based on observation of the animals behavior have—in preference to other species—been the subject of zoological studies which might offer some hope of making their rearing more popular and more profitable.

Once there has been significant production over several years so that crustacean farming can emerge from the experimental stage, there must be a transfer of knowledge, techniques, and husbandry practices to the operators in the field, farmers and potential farmers. This ensures that the technical and financial knowledge required is fully available and may well prevent failures as a result of ill-informed enthusiasm.

Concerning especially crayfish, many of the commercial failures that hold back the rearing and exploitation are caused by would-be producers who model crayfish farming on fish farming (pisciculture), usually because the two animal categories both live in the same environment water. Some countries even classify crayfish under “Fish” in their official regulations.

In another way, when shrimp are mentioned, one customarily thinks of a marine environment. But many of the largest and most desirable shrimps occur in freshwater as the “giant freshwater prawn” (*Macrobrachium rosenbergii*) of the Indo-Pacific region. As well crayfish and giant freshwater prawn have common characteristics: they have white blood, no bones, walk, can leave sometimes the water at night, are equipped with powerful or long claws, and can dig holes and galleries in the ground.

2. Classification

Crustaceans (of which there are approximately 26 000 species) form a tiny class of the vast group of Arthropods, jointed animals with a chitinous exoskeleton, which comprises about 1.1 million species.

The order of Decapoda contains 400 known species of crayfish.

2.1 Crayfish

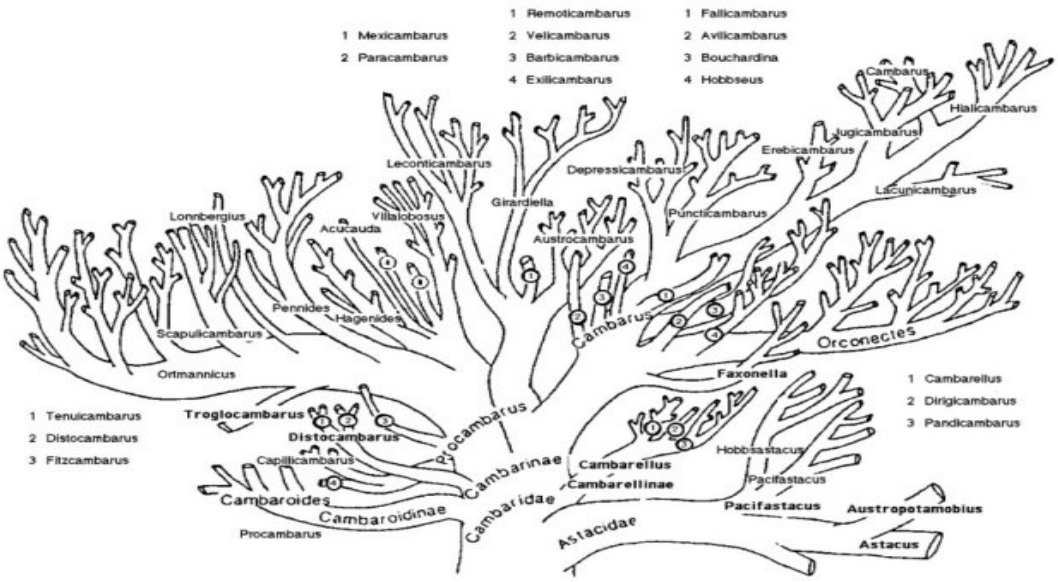

Figure 1. Phylogenetic tree of crayfish (taken from H.H. Hobbs Jr., 1972 in: Holdich and Lowery, 1988).

Two types of crayfish can be distinguished: those of the Southern Hemisphere belonging to the super family of Parastacoidea, and those of the Northern Hemisphere, belonging to the super family of Astacoidea. In these super-families are the important families of the Parastacidae, Astacidae, and Cambaridae.

2.2 Freshwater Prawn

The freshwater prawn is, like all prawns, a Natantia decapod crustacean of the Carides sub-order, and Palaemonidae family. It is a member of the genus *Macrobrachium*, a genus of tropical crustaceans, which lives in fresh or brackish water.

3. Distribution

3.1 Crayfish

Crayfish occur naturally on all of the continents except Africa and a number of coastal and oceanic islands. The ranges indicated in the Figure 2 are believed to represent the outcome of the natural wanderings of the several crayfish stocks but the influence (or not) of man is difficult to establish in some of them.

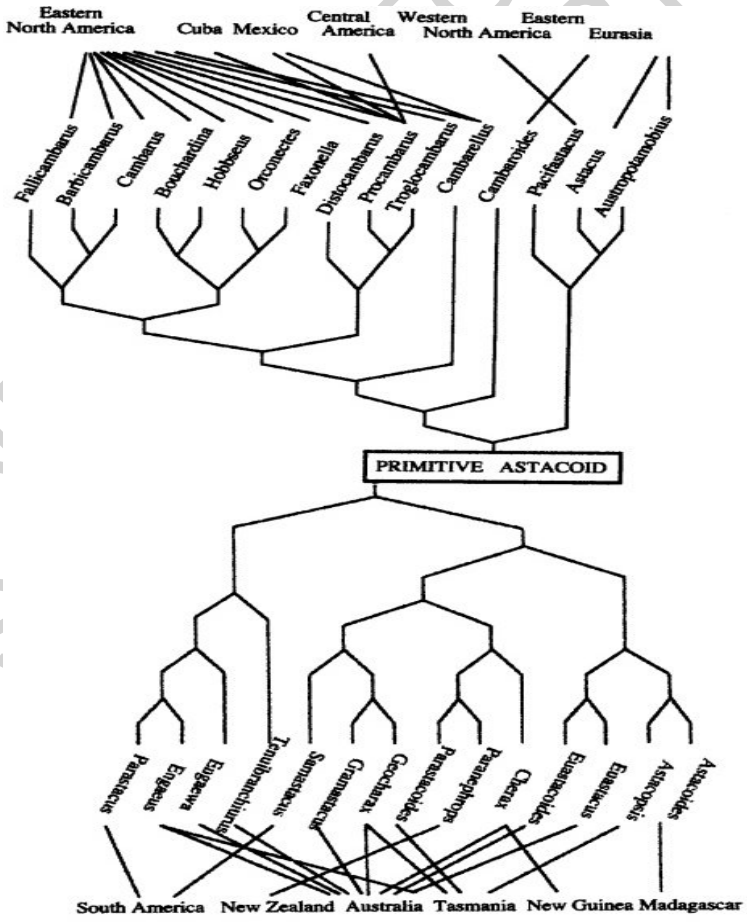

Figure 2. Phylogeny of crayfish families. (Adapted from Holdich and Lowery, 1988).

The astacoids and parastacoids have invaded the fresh waters of the Northern and Southern Hemispheres. Successive adaptations in their osmoregulatory systems would permit these pioneers to exist for long periods of time in water having a lower salt level than that to which they had become adapted.

In the Ponto-Caspian Basin marine protoastacids made the transition from marine to freshwater habitats. During the Tertiary, two basic stocks gave rise to *Astacus* and *Austropotamobius*, became the primary occupant of Western Europe, while those of *Astacus* came to dominate the Eastern sector. It seems that the ancestors of *Pacifastacus* were astacids wanderers from Ponto-Caspian area finding their way across Northern Eurasia to North America.

The most primitive crayfish, members of the genus *Procambarus* would be stream inhabitants of the Southeastern part of the United States, the coastal plain, and only in the tropics of Middle America. The orconectoides stock spread principally to the north and west, constituting the main genus *Orconectes* (to see the arrows on the Figure 3).

Of the three northern elements (Africa, India, and Madagascar), only Madagascar is settled by one endemic genus, *Astacoides*. No satisfying explanation exists for the presence of crayfish in Madagascar, Australia, and South America and their absence in Africa, and the Indian sub-continent.

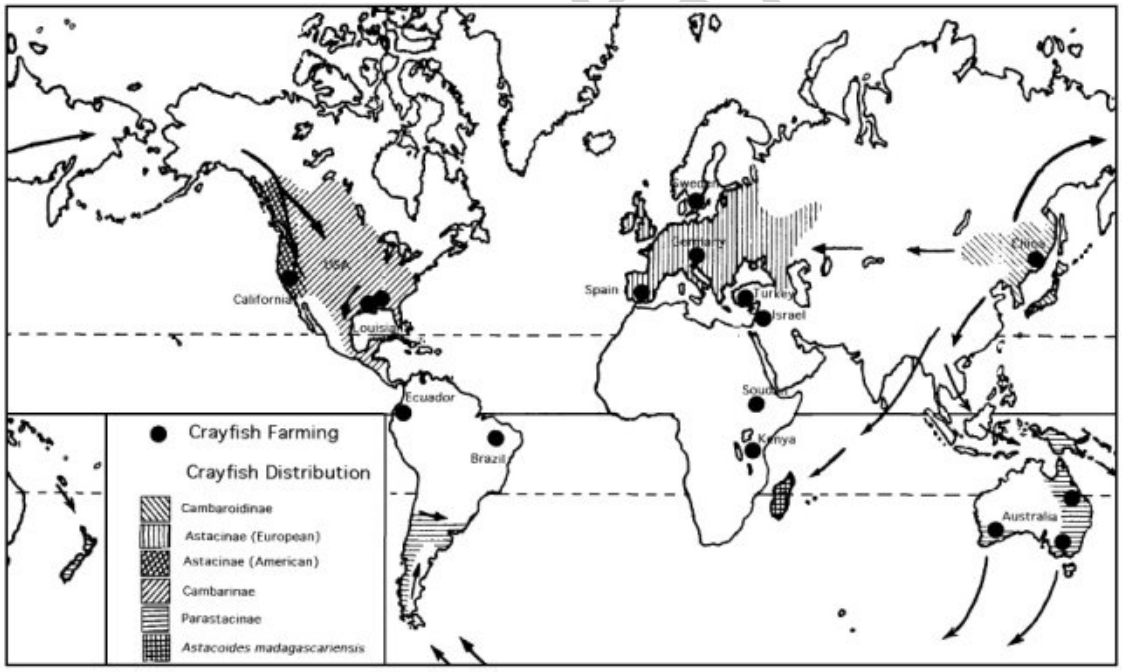

Figure 3. World distribution of crayfish (adapted from Villalobos, 1983).

That is difficult to distinguish the part of man in the ancient spread of crayfish among the world countries. For examples concerning Europe, crayfish was introduced into Sweden in the sixteenth century, and their presence in the Iberian Peninsula, British Isles, Scandinavia, North Germany, and East Switzerland has been attributed to the influence of man. The American spiny cheek crayfish *Orconectes limosus* was

introduced in 1890 into Germany. In the 1960s, stocking of the signal crayfish, *Pacifastacus leniusculus*, American too, started in Sweden and in 1973, the red swamp crayfish, *Procambarus clarkii* was introduced from Louisiana (USA) into Spain. In 1983, the Australian species, yabby (*Cherax destructor*) and, later, red claw crayfish (*C. quadricarinatus*), were introduced into Spain and Italy. The rapid spray of the exotic species of crayfish depends now on their economic interest and on the modern facilities of carrying also.

3.2 Freshwater Prawn

Numbers of prawns were studied mainly in the Indo-Pacific region. For example, *Macrobrachium rude, M. malcolmsoni,* and *M. carcinus* are coincidentally cultured along or not with *M. rosenbergii* in India and Bangladesh; larvae of *M. caementarius* are harvested from the lower end of rivers, raised in tanks, and used to stock both private, and public waters in Peru; *M. lar* is fished in Caledonia.

By far the best known of these is the giant freshwater prawn *Macrobrachium rosenbergii*. In the nature, adult *M. rosenbergii* are found in virtually all types of fresh and brackish tropical waters. Larval development, however, requires water of: 8 to 22 % salinity. It has been exploited for many years. It is traditionally fished in its natural habitat—estuaries, rivers, tropical lakes, and rice channels.

The first brood stock was imported into Hawaii from Malaysia at the beginning of the 1960s. It was from this stock that the first giant freshwater prawns were reared outside the species' natural area. The progeny of this stock, known as "anuenue," though very small in number (36), was used for starting all the farms outside this region, i.e. in Southern USA, Central America, Polynesia, the Caribbean, South America, and the Indian Ocean.

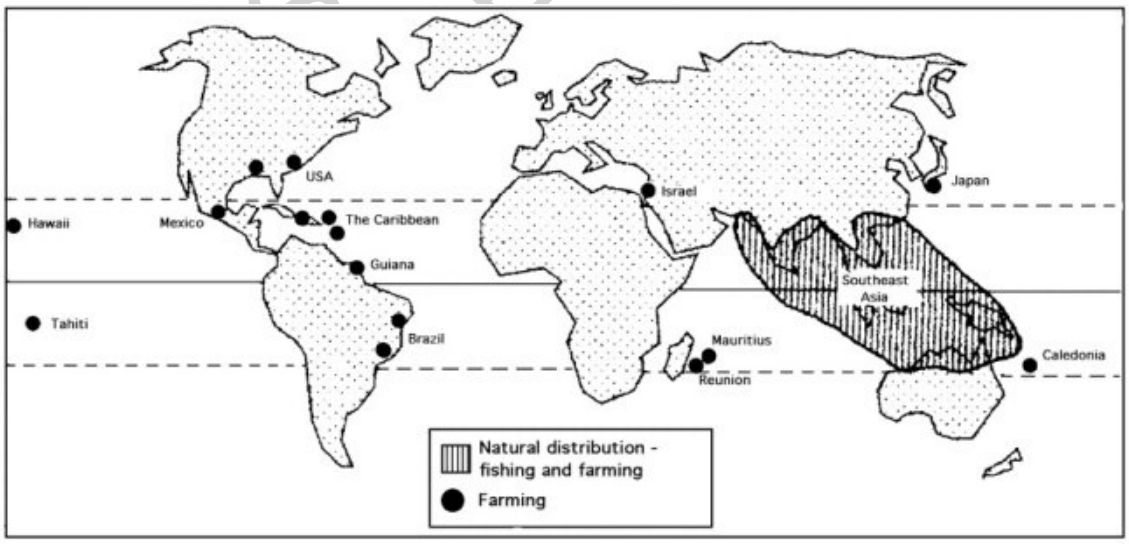

Figure 4. World distribution of giant freshwater prawn (taken from Griessinger, Lacroix, and Gondouin, 1994).

4. Morphology

The morphologies of the crayfish and of the prawn are very closed, the reason why the description will be more explained regarding the crayfish, less concerning the prawn.

4.1 Crayfish

The body of the crayfish has three major sections: the head, the thorax and the abdomen (including the tail, edible for the most part). The head and thorax are joined and form what is called the cephalothorax. The body of the crayfish is divided into 19 segments, called somites that are very visible in the caudal part, while 19 pairs of appendages, arranged functionally, are attached to the somites.

4.1.1 Appendages

The head carries the faceted eyes on eyestalks, together with five pairs of appendages:

- The antennules with chemical receptors for taste and odor
- The antennae ensuring the transmission and reception of sensory stimuli
- The mandibles can cut, tear and crush the food stuff
- The maxillulae and
- The maxillae can chew and manipulate the food

Eight pairs of appendages are fixed to the thorax:

- Three pairs of maxillipeds (the third is the most developed)
- Five pairs of walking legs (hence the name of reptant decapod)

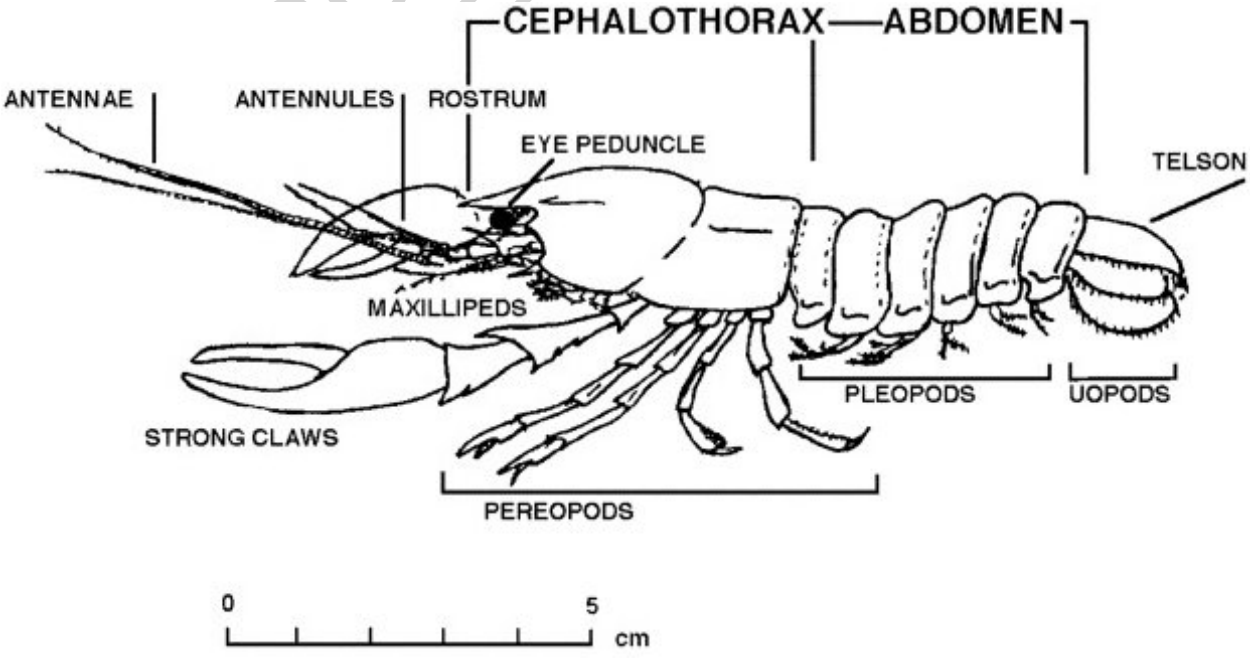

Figure 5. Adult crayfish (after Arrignon, 1996).

The first pair of walking legs carries large claws, called chelae; they are used for food handling, fighting and protection. The four other pairs are used for walking and for cleaning the body; the last two have simple claws at the end.

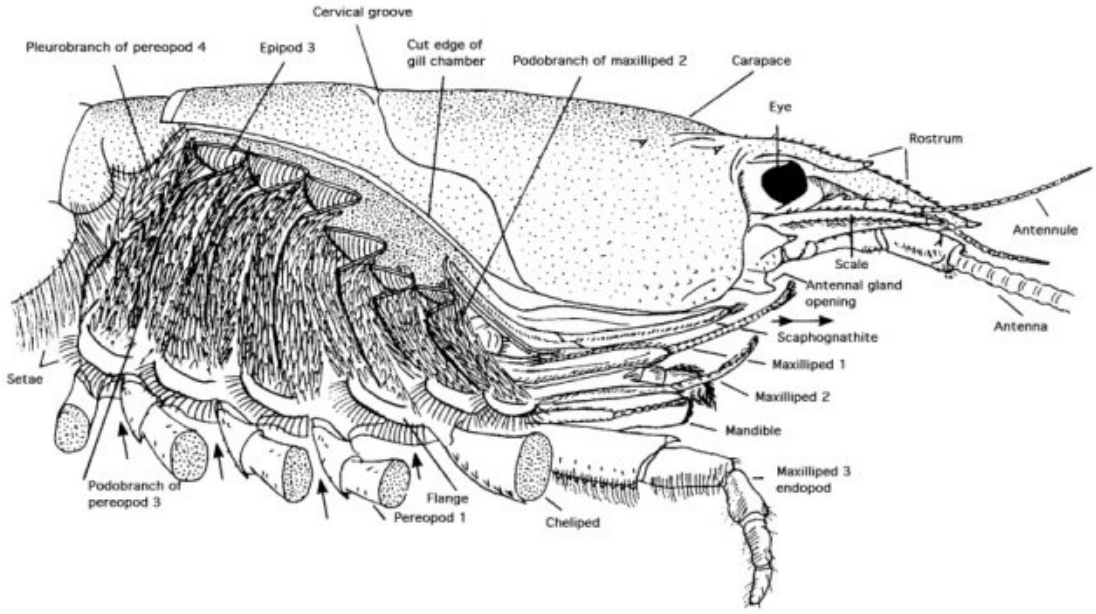

Figure 6. External anatomy (adapted from Marshall and Williams in: Holdich and Lowery, 1988).

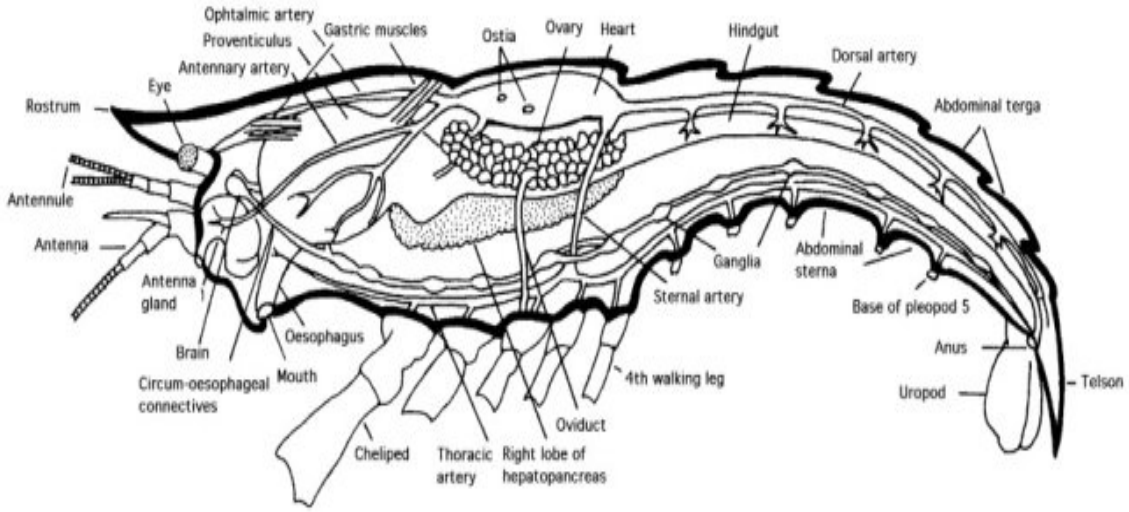

Figure 7. Internal anatomy (adapted from Marshall and Williams in: Holdich and Lowery, 1988).

The abdomen has five pairs of appendages and one pair of uropods, which, with the terminal telson, form a sort of paddle, which acts as retro-propulsive caudal swimming fan. These appendages play a reproductive role: in the sexually active male and during copulation, two pairs of legs are transformed into a sperm-carrying organ; all female appendages fix the eggs during their incubation.

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Biographical Sketches

Jacques C.V. Arrignon, born in 1929, is an agronomical Engineer (University of Nancy, Agricultural Institute) and doctor in marine biology (University of Algiers). He is now retired as Hon. Chief Engineer of Forestry and Water management. He was recently advisor of the UNPF (National Union of French Anglers) and executive vice-president of the European Alliance of Anglers. Formerly: Assistant Director General of the CSP (French Fisheries Board) having in charge of the scientific and technical Department. From 1978 to 1985: scientific advisor by the French Ministry of the Sea having in charge the aquaculture, and international Manager by the FAO for the development of the aquaculture and fisheries in Ivory Coast. Its major publications are: 'Aménagement piscicole des eaux douces' ('Fisheries management in freshwaters') French (5), Spanish (2) English (1) editions, 'L'Ecrevisse et son élevage' ('Crayfish and its breeding') French (3) Italian and Spanish (1) editions, 'Agro-écologie des zones arides et subhumides' ('Agro-ecology of the arid and semi-arid areas') French (1) edition. He is the leader of the collection 'Aquaculture' by the Lavoisier TEC & DOC Publisher.

Hans Ackefors got his Ph.D. from Stockholm University in 1971. He became adjunct associate professor in 1972. In 1976 he was appointed professor in ecological zoology. 1960-1966 he was a lecturer at Stockholm University. 1966-1976 senior scientist at the Institute of Marine Research, Fishery Board of Sweden and from 1976 until 1996 he was the head of the Department of Aquatic Ecology at Stockholm University. He has published about 200 scientific papers in plankton ecology, fisheries science, environmental issues and aquaculture; 2 books on freshwater crayfish, 1 book on aquaculture. He is a member of Royal Swedish Academy of Agriculture and Forestry; Past President at European Aquaculture Society; Expert, International Council for the Exploration of the Sea; Chairman, Commission II (Aquaculture) in EIFAC, 1996-1998: European Inland Fishery Advisory Commission (FAO); Board Member for Skansen Stiftelsen, Stockholm, Sweden. He has worked abroad in a number of countries and with long assignments in USA, Italy and Malaysia.