ADVANTAGES OF ARTIFICIAL REPRODUCTION TECHNIQUES FOR WHITE-CLAWED CRAYFISH (*AUSTROPOTAMOBIUS PALLIPES* LEREBOULLET)

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ABSTRACT

With the aim of preserving and increasing endangered stocks of white-clawed crayfish, research on juvenile production has been carried out. Advantages in application of newly developed techniques of egg storage, transport and artificial incubation techniques are discussed.

Eggs can be removed from maternal pleopods during the early stages of embryonic development and placed in artificial incubation devices. This practice avoids egg losses caused by aggressive contacts, female disease or death and the production of stage-2 juveniles in different batches by means of temperature manipulation. Furthermore transmission of pathogens from broodstocks to offspring can be minimised.

Egg storage and transport have some advantages in the artificial reproduction of crayfish. Firstly, embryonic development continues under storage conditions and thus water and human effort can be saved during this period. Temperature plays an important role on both efficiency rates and duration of embryogenesis. Secondly, egg transport could facilitate restocking programs, as there is no need to move berried females to other habitats.

To sum up, the combined use of artificial incubation and storage/transport techniques could have important applications to the development of astacid crayfish culture.

Key-words: White clawed crayfish, culture, artificial reproduction.

AVANTAGES DE TECHNIQUES RÉCEMMENT DÉVELOPPÉES POUR LA REPRODUCTION ARTIFICIELLE DE L'ÉCREVISSE À PATTES BLANCHES (*AUSTROPOTAMOBIUS PALLIPES* LEREBOULLET)

RÉSUMÉ

Avec la finalité de conserver et d'augmenter les populations d'écrevisses à pattes blanches en danger, des recherches pour la production de juvéniles ont été réalisées. Les avantages de l'application de techniques récemment développées pour le stockage, le transport et l'incubation artificielle d'œufs sont débattues.

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Les œufs peuvent être enlevés des pléopodes maternels pendant les premières étapes du développement embryonnaire et être placés dans les appareils d'incubation artificielle. Cette pratique permet une réduction des pertes d'œufs à cause de contacts agressifs et maladie ou mort de la femelle de même que la production de juvéniles stade 2 en différents lots au moyen de manipulations de la température. En plus, la transmission de pathogènes des géniteurs à la progéniture peut être évitée.

Le transport et le stockage d'œufs ont plusieurs avantages dans la reproduction artificielle de l'écrevisse. D'abord, le développement embryonnaire continue sous les conditions de stockage et donc l'eau et la main d'œuvre peuvent être économisées pendant cette période. La température joue un rôle très important sur les taux d'efficacité ainsi que sur la durée de l'embryogenèse. Deuxièmement, le transport d'œufs pourrait faciliter les programmes de repeuplement puisqu'il n'y aurait pas besoin de déplacer les femelles fécondées vers d'autres habitats.

En somme, l'usage combiné de l'incubation artificielle et des techniques pour le stockage/transport pourrait avoir des applications importantes dans le développement de l'élevage de l'écrevisse.

Mots-clés : Écrevisse à pattes blanches, élevage, reproduction artificielle.

Native crayfish stocks have declined in Europe as a consequence of many factors such as diseases (mainly *aphanomycosis*), climatic changes (drought) and human activities (e.g. habitat alteration, pollution and exploitation) (HOLDICH, 2002). In many countries, native species are threatened and protection plans are necessary. Conservation measures include restocking actions in carefully targeted habitats with the aim of increasing the number of wild populations (REYNOLDS *et al*., 2002, SCHULZ *et al*., 2002).

Stocking material may originate either from existing wild stocks or from crayfish farms. SCHULZ (2000) recommended that a quantitative survey of the potential donor population must be undertaken before taking animals from the wild. Thus, crayfish culture seems to be a suitable alternative to obtaining animals from wild populations, especially when numbers available are low.

In crayfish farms, juveniles are usually obtained through maternal incubation. Females have to clean and oxygenate eggs during long periods of time (lasting between 6 to 8 months) up to stage-1 juveniles. Only after this stage (stage-2), juveniles are independent of the mother. Throughout the embryonic development period, any factor affecting the broodstock could lead to major losses. Aggressive interactions, handling and poor egg attachment have been described by CELADA *et al*. (1988), WOODLOCK and REYNOLDS (1988) and CARRAL *et al*. (1994) as causes of egg detachment and mortality. A total loss of eggs can also take place when berried females die.

Artificial incubation (AI) has several advantages such as a reduced dependence on females and associated egg losses. In addition, stage-2 juvenile production is obtained under controlled conditions making their subsequent collection easier. Incorporation of artificial breeding techniques into crayfish farms could reduce food and space expenses (CARRAL *et al*., 1992; JÄRVENPÄÄ, 1995).

In order to intensify the reproductive phase, AI techniques have been developed by our research team. In this sense and focussing on the white clawed crayfish (*Austropotamobius pallipes)*, eggs can be detached from females in early stages of embryonic development, 34 days after spawning, attaining good survival efficiency rates at stage-2 juveniles (51%) and embracing more than three-quarters of the embryogenetic process (PÉREZ *et al.*, 1998a). It was proved that, under similar conditions, comparable survival levels can be obtained whether incubation takes place in artificial devices (68.2%) or on maternal pleopods (56.2%) (PÉREZ *et al*., 1999).

Temperature plays an important role on both efficiency rates and duration of embryogenesis. Temperature control is most feasible when flow rates and volumes of water are small. Under experimental conditions, a water flow between 0.5 and 1 l/min is suitable for egg densities of 2.2 eggs/cm^2 (CARRAL *et al*. 1992, PÉREZ *et al*., 1998a, 1998b, 1999). PÉREZ *et al*. (1998b) tested different thermal regimes under AI conditions obtaining high efficiency rates to stage-2 juveniles (around 70%) between March 27, and April 15, showing that it is feasible to shorten the incubation period and obtain hatchlings three months earlier than in wild populations. The possibility to control the time of juvenile production by means of temperature manipulation could be useful in management, as restocking can be done when selected habitats have optimal conditions of water flow, temperature, food availability, etc.

Another advantage of AI techniques is the reduction in transmission of pathogens from broodstocks to offspring. The addition of biocides, as is usually done in salmonid egg incubation, could be useful during crayfish reproduction to stop fungus growth on dead eggs. Both egg removal and biocide treatments may assist to obtain disease-free animals.

Once AI had become feasible, egg storage and transport was considered with the aim of developing a commercialization and distribution programme similar to those established in salmonid culture (CELADA *et al*. 2000, 2001). After comparison of several containers, CELADA *et al.* (2001) used polystyrene boxes equipped with a wet sponge for egg storage and transport. In this system, white-clawed eggs were either maintained for up to 42 days or transported for 2.5 hours obtaining a percentage of stage-2-juvenile survival around 65%.

Since embryonic development continues during storage, the need to expend manpower or water is avoided. Nevertheless a critical late embryonic phase that limits the duration of storage was identified by PÉREZ *et al*. (2003) who reported high mortalities when stored eggs reached phase XII (embryo with pulsating heart).

In conclusion, environmental control of crayfish artificial reproduction allows for juvenile production in different batches from February to June (PÉREZ *et al*., 2003).

Egg transport is feasible and storage can be extended at least up to periods longer than three months (PÉREZ *et al.*, 2003). This technique opens new possibilities such as obtaining material for restocking by egg removal from wild females, avoiding their transport and later adaptation to laboratory conditions.

Finally, AI offers the possibility to identify more accurately the origin of offspring, which could be useful for genetic selection programmes.

To sum up, the combined use of artificial incubation and storage/transport techniques could have important applications in the development of crayfish culture for both restocking and grow out purposes.

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