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M. Pedini
Fisheries Department, Food and Agriculture Organisation of the United Nations (FAO),
Viale delle Terme di Caracalla, 00100 Tome, Italy

The objectives of the present TECAM Seminar were to update the situation on the research programmes that are carried out by the Mediterranean countries on the domestication of new finfish species as the initial workshop took place four years before (14 to 17 June 1995, Nicosia, Cyprus). Moreover, the Seminar also tried to revise the different methodological aspects that should be taken into consideration in the process of domestication and in the establishment of plan strategies of new finfish candidates for aquaculture.

This Seminar, which was organised by the CIHEAM-IAMZ and the Fisheries Department of the FAO, was held in Zaragoza (Spain) from 24 to 27 May 1999, and was attended by 82 experts from 17 countries. It was structured with an introductory opening session and two main sessions:

(i) Methodological strategies for the domestication of finfish species.

(ii) Recent advances in Mediterranean marine finfish species diversification.

Through the thirty-seven presentations, ten posters, and specific and general discussions that followed the presentation of papers, the following topics were addressed at the Seminar: (i) marketing of Mediterranean aquaculture species; (ii) methodological strategies for the domestication of finfish species – nutrition and feeding, reproduction aspects, husbandry and health management considerations; (iii) recent advances in Mediterranean marine finfish diversification; and (iv) experiences in new sparids, flatfishes, groupers, seriola, tuna and other species of interest (*Siganus rivulatus*, Mediterranean drum, octopus).

The opening session of the meeting included a presentation by the private sector on enterprise strategies for marketing development of Mediterranean species.

In the keynote speech, the representative from NIREUS company, from Greece, indicated that marine aquaculture development in the Mediterranean basin had followed a production oriented rather than a market oriented approach. This choice had resulted in a clear oversupply of the markets, with total production of marine finfish reaching about 72,000 t in 1997. Consequently, this resulted in marked reductions of the price and profit levels that led to the closure of many production units and to the appearance of a few large companies that tended to dominate the market. It was obvious that the region had not paid sufficient attention to the lessons learnt from the development of salmonid aquaculture in the northern European countries. Market prospects for aquaculture products appeared to be still positive in particular because of the perceived value of the aquaculture product, with value seen as a combination of price and quality. Points on the need for product certification and labeling were raised. Regarding marketing strategies for the new species the attention was brought to the need to avoid that the introduction of new species that could cannibalize market share of existing products. It was remarked that in general the lower the technological advances required for the production of a new species the lower will tend to be the actual marketable diversification. Species diversification alone would not increase company revenues if it is not accompanied by the development of alternative export markets, the expansion of the home market and diversification of product types.

The first major session concentrated on the methodologies/strategies for domestication of finfish species. The initial group of papers dealt with aspects related to nutrition and feeding, and involved three general presentations and a session to discuss the presentations. The papers referred to:

(i) Determination of nutrient requirements.
(ii) Feed formulation, diet development and feed technology.
(iii) Feed allowance and feeding practices.

Some salient points of these presentations included the importance to examine the natural feeding behavior of the new species before starting experimentation in captivity, as well as the way the new species adapts to captivity. In addition the difficulties to obtain comparable information from the literature, due to the variation of the methodological approach on experimental diets, were pointed out. Other points on the first group of presentations related to the interference between the feed formulation and feed processing that requires a close cooperation between nutritionist and feed engineers. Other aspects discussed were related to the determination of optimal feeding levels and to the protocols to be followed to determine feeding charts for the new species. It was highlighted that marked differences exist in the voluntary feed intake of fish related to fish size, environmental parameters, dietary regimes and metabolism differences that are regulated through endocrine and neuronal mechanisms. The discussion session highlighted the practical difficulties for farmers experimenting with new species to track growth curves and food convertion ration (FCR). This is linked to the difficulty to effectively estimate the biomass under culture, although it was highlighted that these parameters are important elements for the development of technical packages for the new species.

The second group of papers (3) of this section dealt with reproduction. Aspects of broodstock maturation, spawning induction, and progeny indicators related to broodstock fitness were discussed. Elements that emerged during these presentations were the list of problems that may affect the spawning process in hatcheries, which led to the conclusion that the best results are obtained with environmental manipulation. Second best options are the gonadotropin hormone analogues that have been synthesized in recent years. If such products have to be utilized for new species, the implants that produce a slow release of the hormone analogues (based on microspheres) are the ones that produce the best results in marine finfish. Regarding the quality criteria for eggs and broodstock, it was pointed out that not much agreement exists on criteria that could be applied to several marine species. The importance of nutrient accumulation in the eggs, coming from the females highlighted the importance that has to be given to broodstock diets. Although some formulas existed for sea bass related to assessment of egg quality on the basis of volume and egg diameter, these formulas did not appear to be accurate for all species. A point that was noted was the importance of fatty acids for egg quality. This conclusion is derived from research carried out in recent years.

A third group of two papers presented husbandry techniques for the new species, with a first paper on the mesocosm concept developed by the Institute of Marine Biology of Crete (IMBC) group in Greece, which was followed by a paper on monitoring parameters for seed quality in wild and farmed Mediterranean fish. In the first paper an interesting classification of the various models of larval production was described. It was based on differences in density, mode of feeding, type of medium, type of environment, and hydrodynamic differences. It was pointed out that in the more intensive or semi-intensive forms the combinations of factors do not work equally well for all the species being tested (as it is also know in the case of sea bass and gilthead sea bream). However, extensive systems based on natural marine food chains seem to be appropriate for all the species so far tested. The mesocosm systems are seen as variants of extensive systems and intend to provide the more natural conditions possible for the early stages of fish larvae.

The second paper approached quality of farmed fish using morpho-anatomical criteria and concentrated on the anomalies found in larvae and juvenile fish, trying to highlight the relationship between the appearance of these anomalies and the technology used for larval rearing. The economic impact of deformities in reared fish was also addressed. The rates of deformities in new species could be an indicator that the larval rearing conditions used for the new species require a different adaptation.

The fourth group of papers was concerned with aspects related to health management. Two papers were presented on health management problems encountered with the new species being tested, including bacterial, fungal, nutritional and parasitic diseases.

The general thematic session was concluded with presentations on the methodologies for domestication, in which the experience of diversification of finfish species in Taiwan, Province of

China, was examined. The domestication process, with the many species which are being farmed by aquaculturist in all the world was discussed. The presentation also dealt with the process followed for selection of new species with good potential for further aquacultural development. The diversification strategies, through introduction of exotic species or through the incorporation of local species were also discussed. The importance of diversification was analyzed from two angles. In first place it had to make maximum use of the facilities available for culture and to balance culture environment, and in second place it had to take into consideration the economic benefits that could be derived from decreasing prices, reduction of risk and improved choice for consumers.

The session continued with a presentation of the results of the survey carried out by CIHEAM in the framework of the TECAM programme, on diversification of new finfish species. As note in the introduction this survey was initiated as a request of the first meetings of this TECAM group. A total of 55 facilities/institutions were contacted out of which 30 replied to the questionnaires that were sent from CIHEAM. From this initial survey it appears that 45 groups in 12 countries are working on diversification of 26 finfish species of which 12 are sparids. It also emerged that market analysis is not carried out regularly prior to the selection of species, and that studies of economic viability are seldom or not at all carried out.

A final paper in this section on methodological approaches outlined the criteria that were followed in France for the screening of *Pollachius pollachius* as a potential species for aquaculture. These were mixed criteria, including biological, marketing and cultural factors. The methods followed to screen the candidate species included four steps, starting with an analysis of the market trends, and following with collection of data on the species, zoo-technical experimentation and techno-economic analysis.

After the general thematic sessions the meeting reviewed a series of papers on the various finfish groups on which experiments are being carried out. The first group, the sparids is the more numerous in terms of experiences. The presentation started with a paper by RIOPESCA, Greece, in which the company described the experiences in the tests carried out so far with *Pagrus pagrus*, *Dentex dentex*, *Puntazzo puntazzo* and *Diplodus* sp. In this interesting presentation the candidate species were compared against the standard species for different stages of growth and for their relative performance. The differences in broodstock performance were reviewed showing that *Pagrus pagrus* may be the species closer to the standard of *Sparus auratus.* Larval quality was compared against the following factors: egg tolerance, first feeding performance, larval tolerance density tolerance, weaning success, larval survival, larval growth rate and through an index of relative performance that combines all these factors. Nursery performance was also evaluated in a similar way against disease tolerance, uniformity of growth, growth rate, density tolerance, handling resistance, current demand and again a relative performance index combining the various factors was applied.

Three more papers were presented on *Pagellus bogaraveo*, *Dentex dentex*, and *Pagrus pagrus.* These papers described the experimental results of the tests carried out on these species and concentrated on the biological information. The discussion that followed these presentation on sparids centered on larval deformities affecting the various species tested. Deformities were noticed in *Pagellus bogaraveo* and *Puntazzo puntazzo*, in particular for opercula. A question on the existing demand for the new species was put to SELONDA. It was indicated that the limited production did not allow yet a clear forecast of demand. However, it was also pointed out that the new species presented some difficulties for marketing/grow-out due to some specific characteristics. Amongst these, the coloration of *Pagrus*, the behavior of *Dentex* in cages, the slow growth and the tendency to get infested with parasites of *Puntazzo* and the slow growth of *Diplodus* were factors playing against a selection of these species. It was also pointed out that strict comparisons between experiments done in different laboratories are often difficult because of the lack of standard models for research on the new species.

The second group of species discussed were flatfishes. The section included two papers on *Solea senegalensis* from Portugal and one paper on *Psetta meiotica* and *Platichthys flesus* from Romania. The work presented by the Portuguese researchers of the University of Faro, referred to the advances in larval culture of sole, where the main problems encountered concerned the diets for the larval and weaning stages, which were linked to the organogenesis of the digestive system in *Solea senegalensis*. The progress achieved on the farming of this species from 1996 till 1999 was described. It concentrated in the trophic behavior of the larval stages that are visual feeders, on a

better understanding of the development of the digestive system both from a point of morphology and of the role of enzymes in digestion, and on the development of technical packages for the weaning stages. The second paper presented on *Solea senegalensis* was on a mechanistic model for simulation of growth of larvae of this species which was based on biochemical principles.

The third paper on flatfishes referred to the experiments being carried out in Romania on the Black Sea species *Psetta meiotica* and *Platichthys flesus*. These species are being tested as diversification of the local mariculture production, mainly based on mussels. These species had been selected on the basis of their high value, and the experimentation on them started in the eighties using the protocols that had been learned at IFREMER laboratories in France. The problems encountered have been mainly related to the lack of adequate feeds and to the difficulty in controlling environmental condition in the facilities available. The discussion that followed the three presentations concentrated on aspects of nutrition of the larval and broodstock stages and on the selection of environmental variables for rearing in captivity. Industry representatives pointed out the need for improvements in the presentations and papers regarding the specific variations of environmental parameters between the different rearing stages.

The flatfish group was followed by presentations on groupers. Three papers, two from Italian researchers on *Epinephelus marginatus* and one from Croatia on this same species, but also indicating results obtained with *E. aeneus*, *E. costae* and *E. caninus*, were presented. In these papers it was evident that research on these species is still in incipient stages in the Mediterranean as none of the groups has yet completed the larval rearing of the local species in sufficient numbers to consider the situation as a pilot stage. Being protogynic hermaphroditic species that become males at late age and large sizes, obtaining good quality milt has been one of the main preoccupations of the research groups. The techniques for induced breeding with use of hormones were described but it was found that none of the groups was able to obtain natural spawnings. One of the main aims of this research seems to be to develop techniques that would allow a restocking of the species in coastal areas. The experiences in Taiwan, province of China, were part of the discussion on this group of species. It was indicated that as a difference with the Mediterranean the industry has moved towards cryopreservation of milt. With the use of green water and larger tanks to stabilize environmental parameters the results in terms of survival of larvae had reached 20%, which can be considered as satisfactory from a commercial standpoint. On the discussion of problems with encephaloviruses found in the Mediterranean it was indicated that similar problems had been encountered in Taiwan, province of China, and that vaccines to counter this problem were being developed.

After the discussion on progress on grouper culture in the Mediterranean four papers on progress on culture of *Seriola* sp. were presented. The papers centered on reproduction and larval rearing of *Seriola dumerili*, on nutritional aspects, and on potential for the farming of the species in Corsica. The paper on reproduction and larval rearing described the efforts of the Ente per le Nuove Tecnologie, l'Energia e l'Ambiente (ENEA), Italy, to breed the species in southern Italy. Broodstock collected from the wild was kept in submerged cages or tanks on land, and were induced to spawn using LH RHa. Eggs and larvae were obtained in 1998 from two females. The species confirmed the potential of fast growth which was already known from the Japanese *S. quinqueradiata.* The papers on nutrition concentrated on the types of food presentation and energy and protein levels required as well as on the food conversion rates obtained in the experiments. It was evident that after extruded diets have been made available for this species, the common belief that the species would not accept dry or semi-dry pellets has been dispelled. The species needs diets with high protein content, in the order of 50%. Up to now FCR of 2.3-2.5 have been obtained, although it is felt that this figure is worse than the real conversion since a good quantity of feed is dispersed in the vortex created by the feeding activity of the fish. The discussion on this species centered on handling problems of such large and active animals at the broodstock stages and on the induction of spawning. The discussion touched also upon the more common diseases in *S. dumerili* encountered in the experiments conducted in southern Italy.

Tuna farming is relatively new in the Mediterranean and was the subject of a separate session in which two papers, one from Morocco and one from the the Spanish laboratories in the Canary Islands were presented. The first paper described the experience of the Moroccan-Japanese project in the Mediterranean and was completed with information on similar experiences of Japanese scientist in Okinawa Islands. The second paper concerned the fattening experience carried out in Canary Islands with juvenile fish of three species collected from the wild and of 3-4 kg of weight, that were reared in

long raceways. The long (40 m) elliptic raceway seem to be acceptable to animals kept in captivity and appears to be the best shape for inland facilities tested so far. In the course of the discussion it was indicated that a new concerted project to be funded by the EC was being prepared by various institutions in the Mediterranean.

After the session on Tuna there was a session on other species or groups of interest in which papers were presented on experiences on culture of siganids in Cyprus and Egypt, on *Umbrina cirrosa* in Greece, and on octopus culture, a species with interesting potential, in both Spain and Italy.

In addition to the presentations of the various papers, a poster session was organized with a total of 10 posters including other species as *Acipenser naccarii* and *Aphia minuta* in addition to the ones discussed in the main sessions.

In the closure of the meeting it was indicated that the proceedings of the meeting will be published in the CIHEAM series *Cahiers Options Méditerranéennes*.