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Committee
Anadromous and Catadromous
Fish Committee

Report of the

THIRD MEETING OF THE I.C.E.S. WORKING GROUP ON MARICULTURE

T A B L E

1. GENERAL

At the 64th Statutory Meeting of ICES in Copenhagen the following resolution (C. Res. 1976/2:25) was passed:

"It was decided, that:

the Working Group on Mariculture should meet from 10 to 13 May 1977 in Brest to discuss the methodology of rearing brood stock and the mass rearing of juveniles of mariculture species for controlled farming and for ocean ranching. The meeting shall take the form of presentation and discussion of experience papers over 3 days, and an additional day will be used for the demonstration of systems and techniques".

The meeting was convened by Prof. Dr. K. TIEWS, Chairman of the Working Group and held in the Centre Océanologique de Bretagne (C.O.B.), Brest, France, from may 10 to 13, 1977, on invitation of the Centre National pour l'Exploitation des Océans (CNEXO), proposed by the French member, Mr. J. LE NOAN. It was attended by 82 participants and 15 observers from 22 different countries. 37 experiences papers were offered, and discussed, in 4 sessions, on the following topics:

Marine Fish Species in General (4 papers), and Marine Flatfish (5 papers) with Dr. A.L.S. MUNRO (U.K.) as discussion leader;

Marine Roundfish (4 papers), and Anadromous and Freshwater Finfish (3 papers), with Dr. C.E. NASH (U.S.A.) as discussion leader;

Shrimps (8 papers), and Lobsters and Crabs (5 papers), with Mr. A. MICHEL (France) as discussion leader.

Gastropods (1 paper), Bivalves (7 papers) and General (1 paper) with Dr. AUDOUIN (France) as discussion leader.

The rapporteurs were Drs M. GIRIN (France), G. PERSOONE (Belgium) and P. SORGELOOS (Belgium).

At the opening the meeting was addressed by Dr. Jacques PERROT, Assistant Director of CNEXO. Prof. TIEWS expressed on behalf of the participants their sincere thanks for the invitation to convene the meeting in Brest and for the excellent local organisation of it for which especially Dr. GIRIN signed responsible.

On May 11 and 12, afternoon excursions were organized by the host to visit several aquaculture facilities of Western Britanny:

- The pilot salmon farm of SODAB (Société pour le Développement de l'Aquaculture en Bretagne) at Tréguier.
- The experimental Abalone hatchery of COB at Argenton.
- The oyster culture facility of Mr. MADEC at l'Aber Wrach.
- The shellfish nursery of the University of Brest at Le Tinduff.
- The salmon net-pen culture unit of COMAT (Coopérative Maritime Aquacole du Tinduff) in l'Auberlach.
- The oyster culture facility of SCORB (Société Coopérative de la Rade) at Le Tinduff.

A list of participants and the agenda of the meeting are given as Appendix 1 - 5.

2. PAPERS.

2.1. Marine fish species in general.

- Paper n° 1.: NASH, C.E. : "The breeding and cultivation of Marine Fish species for Mariculture".

Abstract :

In summary, the culture of the marine fish has not made as much progress as other species in aquaculture, for example the marine and freshwater prawns

The large number of red sea bream released each year by the Japanese into the Seto Inland Sea constitutes one of the major marine fish projects, but the economic benefit for this type of ocean ranching is uncertain, and the cost of the fry is high.

Dover sole and turbot still offer good potential for marine fish culture in European and Mediterranean waters, but many of the farming techniques have been developed for the less valuable but more easily produced plaice. The direction of flatfish farming is moving more toward controlled systems and not the type of ocean ranching which was practiced at the turn of the century, or by Gross (1947) and his colleagues in Scottish sea-lochs.

The grey mullet has increasing farm potential but its commercial markets are limited as it has low value. It is more important as a subsistence brackishwater pond fish in Southeast Asia and other developing regions where animal protein intake relies heavily on such fish.

In order to make marine fish culture or farming more successful during the next twenty years, there is great need for a concentration of effort on a few selected species. There is also need for good facilities built on experiences derived from many workers in the field. Taking the lead from the salmonids, it might be very opportune to concentrate on the migratory species of marine fish, which provide for greater opportunities for total management through ocean ranching The migratory species are more likely to provide the gross tonnages of fish to increase market levels much more than the individual high priced fish cultured in small farms, either on land or in coastal areas.

- Paper n° 2: Ellertsen,B., Moksness, E, Solemdal, P., Tilseth, S. and Oiestad, V.:"Rearing of marine fish fry in ponds on the natural food production"

Abstract:
During 1975 and 1976 survival and growth experiments were carried out in a 4 400 m^3 outdoor basin on larvae of cod (Gadus morhua L.),herring (Clupea harengus L.), plaice (Pleuronectes platessa L.), flounder (Platichtys flesus (L.)) and the hybrid obtained from crossing plaice females and flounder males.

The growth period was in the range 66 -140 days and daily growth rates varied between 0.42-0.75mm for different species.The survival rate was 2-3% for cod, 10-11% for herring, 7-9% for plaice. 23% for flounder and 10% for hybrid. Incubation of pelagic eggs in the basin did not give viable larvae.

The carrying capacity of the basin was 5 300 fry (1.2 fry/m^3) in 1975 and 4 800 fry (1.1 fry/m^3) in 1976. During the pelagic stage of the larvae competition for food occured, but after metamorphosis the different species exploited different niches, favoring a multiculture rearing. The cod fry predated heavily on smaller fry and on larvae, and cannibalism reduced the number of cod fry considerably. The fry produced had learned to hunt for food and escape from enemies and might be suitable for release in the sea being less naive than laboratory-reared fry.

- Paper n° 3 : GATESCUPE, F.J., LUQUET, P. : "Recherche d'une alimentation artificielle adaptée à l'élevage des stades larvaires des poissons. I. Comparaison de quelques techniques destinées à améliorer la stabilité à l'eau des aliments".

Résumé :

Le travail présenté a pour objet de comparer différentes méthodes permettant de conférer une meilleure stabilité à l'eau aux aliments destinés à l'alimentation des larves de poissons.

Les procédés de protection testés sont l'addition de gélatine au régime, l'encapsulation par des polymères synthétiques (nylon) ou naturels (gélatine, zéine), ainsi que l'enrobage par de la zéine.

La stabilité à l'eau des particules alimentaires non protégées est très faible : seulement 3 % de l'aliment sont récupérés par filtration au bout de 4 heures. L'addition de 10 % de gélatine améliore légèrement cette stabilité (13 à 25 %). Si l'encapsulation par le nylon améliore considérablement la teneur à l'eau des aliments (56 à 66 %), ce sont les procédés d'encapsulation par les polymères naturels qui confirment les meilleures qualités technologiques aux particules (74 à 79 %).

Bien que l'enrobage à la zéine procure des résultats inférieurs (35 %), cette méthode est provisoirement retenue en raison de sa facilité de mise en oeuvre, de l'absence de risques de toxicité ou de pertes d'éléments solubles en cours de fabrication et de la possibilité d'incorporation de substances appétentes.

- Paper n° 27 : SORGELOOS, P., BAEZA-MESA, M., BENIJTS, F., BOSSUYT, E., BRUGGEMAN E., CLAUS, C., PERSOONE, G., VANDEPUTTE, G., VERSICHELE, D. : "The use of the Brine Shrimp, Artemia salina, in aquaculture".

Abstract :

In view of the need for research on the practical use of the brine shrimp Artemia in aquaculture, our research team at the State University of Ghent, Belgium is studying the following aspects :

1. The automatized mass-culturing of larvae.
2. The controlled production of cysts.
3. The comparative study of geographical strains of Artemia.
4. The study of the metabolism of Artemia cysts.

2.2. Marine flatfish.

- Paper n° 37 : KINGWELL, S.J., DUGGAN, M.C., DYE, J.E. : "Large scale handling of the larvae of the marine flatfish turbot (Scophthalmus maximus L.), and dover sole (Solea solea L.) with a view to their subsequent fattening under farming condition".

Abstract :

Hatchery procedures for the rearing of relatively large numbers of juveniles Dover sole and turbot used by the British White Fish Authority in 1976 are reported.

Production survivals for both species are given and suggest that commercially viable levels can now be obtained with Dover sole for the initial feeding stage on live diets. The techniques for producing turbot larvae in quantity have not shown repeatable results but individual batches would tend to indicate that economic levels of production may be achieved.

- Paper n° 4 : GIRIN, M., METAILLER, R., NEDELEC, J. : "Accoutumance de jeunes soles (Solea solea) à différents aliments inertes après achèvement de la métamorphose".

Résumé :

Une expérience d'accoutumance à divers aliments inertes est effectuée sur une série de 9 lots de 150 soles âgées de 1 mois, pesant en moyenne 43 mg, habituées à se nourrir d'Artemia salina vivantes. Réalisée dans des bacs carrés de 60 l, à fond de sable percolé, elle dure 2 mois.

Une succession d'aliments naturels congelés, qui s'achève par de la chair du mollusque bivalve Laevicardium crassum, est comparée à deux formules d'aliments composés, présentés sous forme de granulés secs. L'accoutumance à ces granulés est facilitée par l'incorporation de diverses farines naturelles faisant fonction d'attractant, pendant une période transitoire de 6 semaines.

Au terme de l'expérience, le meilleur résultat, 98 % de survie et 1,10 g de poids moyen, est fourni par les aliments naturels. Les farines de Laevicardium crassum et de l'Annélide Polychète Nephthys hombergii se montrent les meilleurs attractants, avec 70 % de survie et 0,99 g en moyenne pour la première, 53 % de survie et 1,10 g en moyenne pour la seconde.

La possibilité d'une application de ces résultats à grande échelle n'est pas démontrée.

- Paper n° 5 : FONDS, M., SAKSENA, V.P. : "The daily food intake of young soles (Solea solea L.) in relation to their size and the water temperature".

Abstract :

The paper reports a series of experiments performed on soles fed with chopped fresh mussel meat. Smaller soles show a maximum food intake at high temperature (26°C), whereas the large fish show maximum feeding at lower temperatures (14-16°C). When food consumption is related to metabolism, the soles appear to be in metabolic equilibrium at 16°C.

- Paper n° 6 : GATESOUPE, F.J., GIRIN, M., LUQUET, P. : "Recherche d'une alimentation artificielle adaptée à l'élevage des stades larvaires des poissons. II. Application à l'élevage larvaire du Bar et de la Sole".

Résumé :

Divers types d'aliments composés enrobés à la zéine sont distribués, soit seuls, soit en association avec des rotifères, à des larves de Bar et de Sole.

Si l'utilisation d'aliments composés seuls a conduit à des résultats décevants, la distribution simultanée de proies vivantes, en quantité limitée, s'est avérée positive : lorsque de faibles charges de poissons (3 à 5 larves / litre) sont retenues, il apparaît possible de dépasser 10 % de survie à un mois pour le Bar et 71 % de métamorphose chez la Sole.

L'analyse des résultats fournis par les différents aliments composés semble indiquer que la supériorité des proies vivantes n'est pas tant leur composition que leur mouvement.

- Paper n° 38 : ADRON, J.M., BLAIR, A., COWEY, C.B. : "Rearing of plaice larvae to metamorphosis using an artificial diet".

Abstract :

The paper reports the results of a rearing experiment performed on batches of 200 Plaice larvae, in 12 l tanks. Survival rate after metamorphosis was 17.5 % in the experimental tank, fed straight from first feeding on laboratory prepared micro-encapsulated diets. It was 38 % in the control tank fed on Artemia nauplii. Behavioral and hygiene aspects of larvae rearing on artificial diets are discussed.

2.3. Marine roundfish.

- Paper n° 7 : BARAHONA FERNANDES, M.H., GIRIN, M. : "Effect of different food levels on the growth and survival of laboratory reared sea bass larvae (Dicentrarchus labrax L.)".

Abstract :

Four batches of 7500 larvae were reared during a period of one month in 150 l tanks at 18°C. The first one was fed on the basis of estimates of the required daily amount of organisms that were made by one of the authors ; the second batch was fed on the average of the estimates made by both authors ; the third and the fourth batches were fed, respectively, with 20 % above and 20 % below this average.

The densities of food in the tanks varied from 0 to 16 organisms/ml before the daily meal and from 1 to 25 organisms/ ml after it. There was no significant difference in the final weight or length of the larvae, although the larvae receiving the highest food level showed a significantly better growth at the age of 15 days. Survival seemed to be better at lower feeding levels. The food conversion rates varied from 34.1 to 15.3 (wet weight) and from 18.7 to 8.4 (dry weight). The best rates were obtained at the lowest feeding level.

- Paper n° 8 : ALLIOT, E., PASTOUREAUD, A., TRELLU, J. : "Evolution des activités enzymatiques dans le tube digestif au cours de la vie larvaire du Bar (Dicentrarchus labrax). Variations des protéinogrammes et des zymogrammes".

Résumé :

L'étude porte sur le développement du système digestif de la larve de Dicentrarchus labrax. Les modifications des activités des enzymes digestives, de l'éclosion à l'âge de 30 jours, ont été inventoriées. 8 activités ont été recherchées : estérases, α-glucosidase, trypsine, chymo-trypsine, leucinaminopeptidase, alcaline et acide phosphatase, en utilisant du gel électrophorétique polyacrylamide.

Toutes les activités sont très faibles à l'éclosion. Les activités de la trypsine, de l'α-glucosidase, et de l'alcaline-phosphatase augmentent entre 0 et 5 jours, diminuent lentement, puis sont très stables entre 15 et 30 jours. Les autres activités augmentent régulièrement entre 0 et 20 jours.

Les relations entre le processus de développement du système digestif et les modifications des activités sont analysées.

- Paper n° 9 : METAILLER, R., MERY, C., DEPOIS, M.N., NEDELEC, J. : "Influence de divers aliments composés sur la croissance et la survie d'alevins de Bars (Dicentrarchus labrax)".

Résumé :

Une vingtaine d'aliments composés sont expérimentés sur de jeunes bars de 400 mg à quelques grammes, en trois séries de tests de grossissement où la croissance et la survie sont enregistrées régulièrement.

Les besoins en protéines de l'espèce semblent être voisins de 47 à 50 % du régime. La couverture énergétique paraît être assurée par un apport de 11 à 12 % de lipides.

Les farines de poissons constituent la majeure partie de la ration. Cependant les autolysats de poisson et les levures apparaissent comme très intéressants à incorporer dans le régime.

- Paper n° 11 : KITTAKA, J. : "Red sea bream culture in Japan".

Abstract :

The paper reviews the history and present situation of Red Sea Bream culture in Japan. Details are given on the techniques of maturing and spawning the breeders in captivity, fertilization, and conditions of hatching of the eggs. Larvae rearing is described, including data on feeding, stocking conditions, handling, survival, and growth rate, both indoor , and using an outdoor large scale production method.

2.4. Anadromous and freshwater finfish.

- Paper n° 12 : HARACHE, Y., BOEUF, G., CHARTOIS, H. : "Résultats d'adaptation à l'eau de mer de jeunes saumons coho (Oncorhynchus kisutch Walbaum) pendant l'automne et l'hiver".

Résumé :

La croissance du saumon Coho (Oncorhynchus kisutch Walbaum) en eau douce est très rapide dans les conditions naturelles de la Bretagne.

Certains poissons présentent un état apparent de smoltification à partir de Septembre de la première année et sont aptes à être transférés dans le milieu marin pour réaliser un cycle de production hivernal avec une croissance supérieure à celle que présentent les poissons maintenus en eau douce.

Quinze transferts directs en eau de mer (34 - 35 %) réalisés du 8 Septembre au 1er Février montrent une relation étroite entre la taille du poisson et le succès de l'adaptation. Les mortalités constatées font apparaître une variation saisonnière de la tolérance à l'eau de mer qui est minimale en Novembre et Décembre et maximale en Février pendant la période étudiée. La taille limite compatible avec une croissance satisfaisante en eau de mer augmente d'un minimum de 170 mm début Septembre à 210 mm début Février.

La croissance apparaît supérieure pour les transferts précoces, la période la plus favorable étant située fin Septembre - début Octobre. Cependant, dans tous les cas, on note une diminution de croissance pendant les quatre semaines qui suivent le transfert, indiquant un stress important qui pourrait être atténué par une adaptation progressive au milieu marin.

- Paper n° 13 : PIGGINS, D.J., LAWRIE, J.P. : "Rearing salmon and rainbow trout for sea cages".

Abstract :

The paper presents an account of the rearing policy and techniques in use at the present time by the Salmon Research Trust of Ireland. Details are given on the brood stocks, the conditions of incubation, first-feeding, and on-rearing, the husbandry standards, and the transfer to sea cages, together with a brief information on rainbow trout culture.

- Paper n° 15 : HOGENDOORN, H. : "Progress in the controlled propagation of Clarias lazera (Cuvier & Valenciennes)".

Abstract :

Subsequent to the existing work concerning the culture of Clarias lazera (C. & V.) it was tried to increase the effectiveness of it's propagation through artificial reproduction. Hypophysation to induce the release of eggs followed by stripping and artificial fertilization gave promising results. The eggs were incubated and hatched successfully and work on fry rearing was started. Although additional work needs to be done, it is felt that good perspectives are held to resolve the problem of fingerling availability in the culture of Clarias lazera.

2.5. Shrimps.

- Paper n° 16 : LAUBIER-BONICHON, A., VAN WORMHOUDT, A., SELLOS, D. : "Croissance larvaire contrôlée de Penaeus japonicus Bate, enzymes digestives et changements de régimes alimentaires".

Résumé :

Le développement de la crevette Peneide Penaeus japonicus Bate, dans les premières phases de sa vie larvaire et post-larvaire a été étudié en suivant l'évolution des acides nucléiques, des protéines et des enzymes digestives. La multiplication cellulaire estimée par le taux de l'acide désoxyribonucléique (ADN) est importante durant la phase nauplius. Pour l'acide ribonucléique (ARN), son évolution est comparée à celle du poids sec et des protéines ; une augmentation importante du taux d'ARN a lieu au stade zoé. On en conclut que les phases nauplius et mysis sont caractérisées par une hyperphasie, alors que la phase zoé est marquée par une hypertrophie cellulaire.

L'étude des activités amylasiques (A) est protéasique (P) et surtout de leur rapport (A/P) aboutit à la mise en évidence d'une prépondérance d'un régime glucidique durant les premières phases s'alimentant, zoé et mysis, et d'un régime protidique à partir de la métamorphose.

- Paper n° 18 : L'HERROUX, M., METAILLER, R., PILVIN, L. : "Remplacement des herbivores proies par des microparticules inertes ; une application à l'élevage larvaire de Penaeus japonicus".

Résumé :

Le présent travail a pour objet la description d'une technique d'élevage des larves de Penaeus japonicus ne faisant intervenir que des algues unicellulaires et des microparticules inertes. L'utilisation de ces dernières est comparée avec celle des proies animales vivantes, plus classiquement employées.

- Paper n° 19 : AQUACOP : "Observations sur la maturation et la reproduction en captivité des crevettes Peneides en milieu tropical".

Résumé :

Le développement des élevages de crevettes Peneides est actuellement limité par les problèmes que pose l'obtention en routine de la reproduction en captivité. En Polynésie où aucune espèce d'intérêt commercial ne se trouve à l'état naturel, cette obtention était un préalable nécessaire. Les observations effectuées au Centre Océanologique du Pacifique du CNEXO ont porté sur 6 espèces du genre Penaeus (P. merguiensis, P. aztecus, P. japonicus, P. monodon, P. vannamei et P. stylirostris) élevées et maintenues dans des bacs extérieurs de 12 m^2 en circulation ouverte.

Avec des températures variant de 25 à 32°, une salinité de 35 ‰ et un pH voisin de 8,2 maturations et pontes s'observent toute l'année et plusieurs générations ont été obtenues : P. merguiensis, F7 ; P. aztecus et P. japonicus, F3 ; P. monodon, F2 ; P. stylirostris et P. vannamei, F1. Pour P. aztecus et P. monodon, la maturation est induite par épédonculation unilatérale.

Le comportement des animaux, la copulation et les signes extérieurs du développement des ovaires sont décrits. Les facteurs qui paraissent essentiels au bon déroulement du processus de maturation sont la température, l'éclairement, l'alimentation et l'état de santé des animaux.

Quoique la viabilité des oeufs ne soit pas encore toujours satisfaisante, il apparaît qu'il sera possible dans un proche avenir de soutenir un élevage de type commercial à partir de reproducteurs maintenus en captivité.

- Paper n° 20 : AQUACOP : "Elevage larvaire de Péneides en milieu tropical".

Résumé :

Afin de pouvoir utiliser au mieux et élever séparément les pontes de crevettes Péneides obtenues à partir de reproducteurs en captivité l'équipe du Centre Océanologique du Pacifique du CNEXO a adapté au milieu tropical la technique en faible volume et forte densité mise au point par le laboratoire de Galveston

Les conditions d'environnement, en particulier les températures élevées toute l'année, ont permis de développer une écloserie simple, demandant le minimum d'investissement. L'eau, préalablement chlorée puis déchlorée, n'est renouvelée qu'à partir du stade mysis. Des algues Cylindrotheca et Tetraselmis produites à part sont utilisées pour les stades zoé, des rotifères pour les stades mysis et des nauplii d'Artemia de P1 à P5, âge auquel les post-larves sont placées en bassin. Des résultats de 100 P/litre sont obtenus en bacs cylindroconiques de 0,5 et 2 m^3. Les manipulations sont réduites et demandent une seule personne, pour une capacité théorique de 2 millions de post-larves par mois.

Des attaques bactériennes et fongiques qui décimaient souvent les élevages ont été contrôlées par l'utilisation d'antibiotiques et d'un herbicide (Treflan). Toutefois certaines mortalités restent encore inexpliquées.

Cette écloserie qui est passée progressivement de l'échelon expérimental à l'échelon pilote a permis de produire environ 2 millions de post-larves des espèces P. merguiensis, P. aztecus, P. japonicus, P. monodon, P. stylirostris et M. ensis. La simplicité des installations devrait permettre d'obtenir un coût de production très bas.

- Paper n° 21 : KITTAKA, J. : "Recent progress in penaeid shrimp culture".

Abstract :

The paper describes the large scale production method developed in Japan, for penaeid shrimps, since 1965, and applied successfully in this country on Penaeus japonicus, and in the U.S.A. on P. aztecus, P. setiferus, and P. duorarum.

Details are given on hatching conditions, larvae and post-larvae rearing, collection and transportation of the post-larvae, and pen grow-out, from the point of view of both the methodology used, and the results achieved.

Several problems of pathology, live food availability, and suitability of the various species for culture, depending on the location, are discussed.

- Paper n° 36 : RICHARD, P., CECCALDI, H.J. : "Variations des caractéristiques pondérales et des compositions amino-acide et protéique pendant le développement embryonnaire de Palaemon serratus".

Résumé :

Les variations des poids humide et sec des oeufs en fonction de la taille des femelles, ainsi que des teneurs en acides aminés libres, protéines et lipoprotéines ont été analysées durant le développement embryonnaire. La composition amino-acide des protéines et des lipoprotéines a également été déterminée.

Le poids humide des oeufs augmente fortement durant l'embryogénèse, alors que le poids sec reste pratiquement constant. Le poids des oeufs est directement, et étroitement, corrélé à la taille des femelles.

La teneur en acides aminés libres totaux est multipliée par quatre entre la ponte et l'éclosion, reflétant l'augmentation de quelques acides aminés : proline, glycine, alanine, acide glutamique, alors que les proportions des acides aminés dits essentiels diminuent, surtout celle du tryptophane.

La légère diminution de la concentration protéique totale au cours du développement rend compte de la formation des protéines de l'embryon aux dépens des lipoprotéines du vitellus. Les compositions en acides aminés des protéines et des lipoprotéines vitellines sont très voisines, seuls quelques acides aminés diffèrent légèrement : lysine, sérine, cystine, isoleucine. Au cours de l'embryogénèse, elles ne varient presque pas.

- Paper n° 22 : AQUACOP : "Production de masse de post-larves de Macrobrachium rosenbergii (de Man) en milieu tropical : Unité pilote".

Résumé :

Depuis 1973, dans le cadre d'un contrat avec le Territoire de Polynésie Française, le Centre Océanologique du Pacifique (Vairao - Tahiti) du CNEXO, a mis au point une technique originale de production de masse de post-larves de Macrobrachium rosenbergii, à l'échelle expérimentale : haute densité (plus de 100 larves/litre), eau claire stagnante, préalablement traitée, renouvellée chaque jour ; contrôle quotidien et rigoureux des conditions du milieu et des larves ; production moyenne 50 post-larves/litre.

Une écloserie pilote a été réalisée fin 1976. Les installations et le premier cycle de production, qui a abouti à la mise en grossissement d'un demi-million de post-larves, sont décrits et analysés. Les résultats obtenus confirment la fiabilité de la technique et la possibilité de passer des volumes d'élevage unitaires expérimentaux de 800 litres à ceux de production de 2 m^3.

Le coût de production (en frais de fonctionnement) a été de 81 FF/1 000 PL (16 US $) et il semble possible de l'abaisser facilement à 35 FF/1 000 PL (7 US $).

La simplicité des installations, allant de pair avec un contrôle rigoureux de l'élevage doit permettre d'adapter rapidement cette technique dans des contextes d'environnement différents.

- Paper n° 23 : EBLE, A.F., EVANS, M.C., DEBLOIS, N.F., STOLPE, N.E. : "Maintenance of brood stock, larval rearing and nursery techniques used to grow Macrobrachium rosenbergii in Waste-Heat discharge waters of an electric generating station in New Jersey".

Abstract :

The paper describes the Macrobrachium culture operations in Trenton, New Jersey, based on the use of waste-heat discharge waters from a power station, allowing for the commercial production of a tropical species in a temperate area.

The brood stock is maintained in small concrete vaults, using closed cycle techniques. Animals thrive and breed normally. Average fecundity is 3-4 berried females per week per tank for all seasons of the year.

Larvae are raised in 100 and 400 l tanks, from stages 1-5, using closed cycle techniques and Artemia nauplii as food. Stages 6-11 are grown in 100 l tanks, with synthetic food fortified with minced fish.

Juveniles are grown in indoor heated nurseries preliminary to pond stocking. Surface area of water column is augmented through use of fabricated substrates. The marketable size (11-13 cm) is reached in a five-month outdoor growing season.

2.6. Lobsters and Crabs.

- Paper n° 24 : LE GALL, J.Y., MAUVIOT, J.C., METAILLER, R., BERTHOU, P. : "Croissance et survie du homard (Homarus vulgaris) pendant les quinze premiers stades en élevage et sous alimentation composée".

Résumé :

Des homards juvéniles ont été élevés pendant huit mois en logettes individuelles, permettant ainsi de suivre la croissance par individu. Les animaux ont été répartis en 5 lots, chaque lot recevant une nourriture différente : aliment frais ou aliment composé présenté sous 4 formes différentes. L'expérience a permis de collecter des résultats originaux sur la croissance des juvéniles en élevage pendant les 15 premiers stades, la qualité de l'aliment composé spécialement défini pour cette étude. Les observations portent sur l'accroissement en taille et en poids à chaque mue, la relation taille/poids et la relation longueur totale/longueur céphalothoracique.

- Paper n° 25 : CARLBERG, J.M., VAN OLST, J.C. : "Methods for culturing the American lobster (Homarus americanus)".

Abstract :

The objectives of this research are to evaluate the usefulness of waste heat from steam electric generating stations as an inexpensive and suitable source of warmed seawater for use in aquaculture of American lobsters and to develop the techniques and systems necessary for the commercially viable culture of this species. Growth rates of larval and juvenile stage lobsters are significantly greater in effluent of elevated temperature than at ambient ocean temperature, while survival is essentially the same in water of effluent and ocean quality. Water quality analyses suggest that concentrations of heavy metals and chlorinated hydrocarbons are similar in each water source. These concentrations are at least an order of magnitude below the mean lethal limits in acute toxicity studies.

In the past decade many biological and technological problems involved in culturing the American lobster, Homarus americanus, have been solved. Culture techniques have been developed for the larval and juvenile stages and current research efforts are directed toward controlling reproduction, reducing cannibalism, refinement of artificial diets, and developing methods of disease prevention. There is general agreement that the major constraint to commercial production is the limited ability to rear large numbers of juveniles to market size, using methods that are both economical and dependable.

The high rates of cannibalism which have been documented for H. Americanus reared communally dictate that for a majority of the culture period the lobsters should be reared individually, in order to eliminate these losses. Criteria essential to the development of culture systems for the intensive rearing of lobsters and other cannibalistic crustacean species in individual holding compartments are considered. Latest cost projections indicate that lobster culture utilizing these systems may be economically feasible.

- Paper n° 40 : CASTELL, J.D. : "Production of juvenile Lobsters (Homarus americanus) for nutrition research".

Abstract :

A simple static system for rearing lobsters (Homarus americanus) through their larval stage is described. The need for frequent daily feeding is overcome by supplying each tank of larvae with newly hatched brine shrimp (Artemia salina) nauplii each day. Survival of 50 percent of the larvae to the juvenile stage is routinely obtained with a minimum amount of labour. This system easily provides more than enough juvenile lobsters for use in nutrition trials. These juveniles appear healthier and exhibit greater survival beyond the fourth stage than those reared on frozen adult brine shrimp in a continuous flow system.

- Paper n° 41 : AIKEN, D.E., WADDY, S.L. :"Communal rearing of juvenile lobsters (Homarus americanus) in a culture system".

Abstract :

Communal rearing is an alternative to individual rearing in the first 6-12 months of a lobster's life a culture system, and higher losses due to cannibalism and injury may be offset by reductions in maintenance and labor. Two essentials forcommunal rearing are a self-cleaning tank and an effective rearing substrate. We examined a PVC tube matrix and the shells of three species of pelecypod molluscs for effectiveness as rearing substrates and found that shells of the oyster Crassostrea were most effective for the first 6 months of juvenile life. After thc first 2 months the largest lobster is often three times the length of the smallest, and if the population is then sorted by size and restocked, each of these size groups subsequently displays this same growth differential, indicating that growth rate is strongly influenced by social pressures. This mechanism of sorting and restocking by size may be used to produce greater numbers of large lobsters in the first 6-10 months of culture.

- Paper n° 26 : SHLESER, R.A. : "Crustacean culture at the Bodega Marine Laboratory (Homarus americanus, Cancer magister)".

Abstract :

The paper reviews the knowledge available on Lobster culture and Crab and describes the research currently undertaken in the Bodega Bay Marine Laboratory. Information is given on food, water quality, disease, reproduction, breeding and genetics.

2.7. Gastropodes.

- Paper n° 28 : FLASSCH, J.P., WOITELLIER, E. : "L'élevage de l'ormeau, Haliotis tuberculata L. 1. Action d'un régime alimentaire d'algues phytoplanctoniques sur la croissance post-larvaire.

Résumé :

Cette étude porte sur l'action du régime alimentaire d'algues unicellulaires sur la croissance post-larvaire de l'ormeau Haliotis tuberculata de la fixation jusqu'à 60 jours, en fonction de différents types d'élevage (circuit ouvert, circuit fermé, eau stagnante). Les courbes de croissance obtenues en fonction de ces différents paramètres sont ajustées à une fonction exponentielle $L = a.e^{bt}$.

Ces résultats ont été adaptés à une production à grande échelle dans le cadre d'une écloserie expérimentale.

2.8. Bivalves.

- Paper n° 30 : BUESTEL, D., ARZEL, P., DAO, J.C. : "La production de juvéniles de Coquille Saint-Jacques (Pecten maximus L.).

Résumé :

La communication s'attache à réaliser une synthèse de deux approches différentes de la production de jeunes Coquilles Saint-Jacques : l'élevage larvaire en laboratoire, et le captage de naissain en mer.

Les méthodes et les résultats d'une série d'expériences d'élevage en laboratoire, sont présentés. Au stade actuel, il est possible d'en attendre des animaux de l'ordre de 1 mm, avec 1 % de survie, 3 mois $\frac{1}{2}$ après la ponte, mais la croissance est mauvaise après la métamorphose.

Les principes et les résultats d'un programme de captage de naissain lancé en 1973, susceptible de collecter 1,5 million de naissains de 12 à 15 mm par saison, sont présentés et discutés.

Les deux méthodes pourraient se rejoindre au niveau de cultures suspendues d'animaux de 5 à 10 mm produits en écloserie.

- Paper n° 31 : LUCAS, A. : "Culture of the Manila clam Venerupis semidecussata Reeve from hatchery-reared spat".

Abstract :

Cultures of Venerupis semidecussata achieved in Rade de Brest from hatchery-reared spat, include three stages, according to the size of the individuals. From 2 to 10 mm : culture in nursery ; from 10 to 20 mm : off-bottom or suspended culture in the wild ; from 20 to 40 mm : suspended or on-bottom culture. The latter stage was not dealt with in the present paper.

In the nursery, 12 major factors affecting the growth rate were considered. For each experiment in the nursery, the particulars of those factors were noted and the influence of five of them was analysed at length. Monthly weight growth rates over 100 % were obtained in spring, autumn and winter.

Suspended culture in partitioned creels made it possible to obtain, in summertime, monthly weight growth rates ranging from 37 % to 133 %, whereas, in the same period of time, with samples of same origin, this rate was only of 7 % to 19 % for off-bottom cultures in screened boxes.

- Paper n° 32 : AQUACOP : "Elevage larvaire et production de naissain de C. gigas en milieu tropical".

Résumé :

En vue de développer l'ostréiculture dans les îles du Pacifique Sud et plus particulièrement en Polynésie Française, des essais de production en écloserie de naissain de C. gigas ont été menés au Centre Océanologique du Pacifique du CNEXO à Tahiti.

Les conditions du milieu tropical considéré (température élevée toute l'année, eaux naturellement peu productives) ont amené à développer des solutions particulières en ce qui concerne le maintien des reproducteurs, et à utiliser lors de l'élevage larvaire une souche d'algue isolée localement et des traitements préventifs par antibiotiques. Pour la fixation, la technique retenue a été celle sur brisure de coquilles de façon à produire du naissain libre.

Ce texte présente et discute les résultats obtenus dans l'écloserie expérimentale au cours de quatre séries d'élevages effectués entre septembre et novembre 1976 où environ 250 000 naissains ont été produits. Les bacs d'élevage de 800 litres cylindroconiques où l'eau est renouvelée tous les 2 jours doivent permettre d'obtenir en routine 1 million de larves prêtes à se fixer.

- Paper n° 33 : PRUDER, G.D., BOLTON, E.T., EPIFANIO, C.E. : "Hatchery techniques for a controlled environment molluscan maricultural system".

Abstract :

The hatchery operation which is part of the Delaware controlled environment system is reliable and trouble free. An abundant supply of quality food is necessary to operate a successful hatchery. The broodstock, larvae, spat and juveniles all receive the same two-part algal diet. The temperature for all except the broodstock is 27-29°C. Sexually mature 16 week oysters are being considered as broodstock. "Astroturf" is being considered as a setting substrate. No assurance exist that our hatchery product which excels within the system would succeed in natural planting.

- Paper n° 42 : Y. LE BORGNE : "L'écloserie-nurserie de la SATMAR et les possibilités actuelles de production de naissain de mollusques bivalves".

Résumé :

L'écloserie-nurserie de la Société Atlantique de Mariculture fonctionne depuis 1973 et emploie 11 personnes. La production atteint 10 millions de post-larves par semaine. Les espèces produites sont : Crassostra gigas, Ostrea edulis, Mercenaria mercenaria, Venerupis decussata, Venerupis semidecussata, Venus verrucosa.

La SATMAR coopère avec la profession conchylicole en fournissant du naissain indispensable (c'est la cas des palourdes) et avec les laboratoires de recherche (participation au programme ECOTRON 1975 et 1976 établi par le CNEXO).

- Paper n° 34 : UKELES, R. : "Culture of algae for feeding larval and juvenile molluscs in controlled aquaculture".

Abstract :

The paper describes the salient points of the prototype model developed at the Milford laboratory for algal food culture.

The various possible methods that have been used for phytoplancton culture are briefly described, and their advantages and disadvantages are discussed. The method used at Milford relies on axenic, highly controlled techniques, using test-tubes, erlenmeyers, and 18 liters carboys. Whenever necessary, large productions can be obtained, with a lower control, from open 1500 l fiberglass tanks.

In order to improve the reliability a of the culture, several new techniques have been developped, particularly culture on pre-sterilized filter paper discs, and long-term cryopreservation.

In order to reduce the cost of the culture, several tests have been performed with modified nutrient mixtures, either reducing the proportion of some components, or suppressing the unnecessary ones.

2.9. General

- Paper n° 35 : BLOGOSLAWSKI, W.J. : "Ozone as a disinfectant in mariculture".

Abstract :

The paper reviews the importance of the economic losses generated by disease treatments in mariculture operations, and the possible methods of disease prevention, with particular reference to ozonisation.

The history of microbial control in seawater through ozonisation is related, and several examples of the efficiency of the method, either on laboratory or industrial scale are described and discussed.

The basic biochemistry of sterilization through ozone treatment is briefly reported.

3. DISCUSSION

3.1. Finfish

The rearing of several hundred thousand larvae of marine finfish past metamorphosis, on live food, has todate been realized successfully on a few species only, namely Plaice (Pleuronectes platessa), Sole (Solea solea), Red Sea Bream (Chrysophrys major), and Sea Bass (Dicentrarchus labrax). In the near future, success with Mullet (Mugil cephalus), Milkfish (Chanos chanos), Turbot (Scophtalmus maximus), Gilthead Sea Bream (Sparus aurata), and Rabbitfish (Siganus rivulatus) is likely.

One of the common problems presently encountered with many species, at any scale, is the high mortalities related to gas bubble symptoms, which occur 1 to 4 weeks after the start of feeding, when the fish swim close to the surface, before the completion of metamorphosis.

The live feed offered during the larval rearing are mostly cultured Brachionus and Artemia, and Copepods caught from the wild. There is presently no important research effort towards new food organisms. On large scale, the only practical problem associated with Brachionus production is the mass culture of algae. A shortage of Artemia cysts results in a bottleneck for the expansion of pilot scale and commercial hatcheries. However, in view of the reported very high potential for the harvest of Artemia cysts at many sites all over the world, it looks like the present production could be increased widely in the next few years.

The rearing techniques are shifting back from the utilization of tanks from several tens of m^3 or more, to smaller ones. At the same time, the stocking densities of newly hatched larvae have increased above 10, and sometimes up to 50/l.

After metamorphosis, in some species such as ~~f.ex.~~ the Read Sea Bream, the young fish, weighing less than 100 mg, for a length not exceeding 40 mm, are widely used for restocking natural areas. The subsequent studies to determine the survival of the fish after release, or return to the fishery are however virtually ~~inexisting~~ non existent.

When intensive culture techniques are applied for ongrowing, the larvae are weaned as soon as possible on fabricated diets. The methods are well established with the Red Sea Bream and the Sea Bass, for production of several hundred thousands of animals, with survival rates usually over 50 %. For Sole diets are still being tested at the laboratory scale.

Important progress would be achieved if live feeds were replaced by suitable fabricated diets right from the start, as is current practice in Salmonid culture. Although to date some preliminary successes have been obtained, it is clear that further research is needed to achieve this objective with other species. It is interesting to note that, except for Salmonids, the same feeding problems exist in the culture of the larvae of many fresh-water fishes.

For the cultivation of weaned juveniles, it appears that most of the information presently available, either on the diet, the physiology in relation to the environment (particularly temperature and salinity), the behaviour, or the pathology, concerns Salmonids. However, some information is coming out on marine species, particularly Sole, Tarbot, Red Sea Bream and Sea Bass.

3.2. Crustaceans

The major effort in Crustacean culture is focused on Penaeid shrimps (among which Penaeus japonicus is already cultured at commercial scale), Macrobrachium rosenbergii and the American lobster Homarus americanus.

The problems in feeding the larval stages of decapod Crustaceans seem to be analogous to those already mentioned for the culturing of fish larvae. An important research effort is being undertaken presently to replace Artemia nauplii by fabricated diets due to the present critical shortage of cysts.

Interesting biochemical studies are in progress on the physiology of digestion. They will hopefully contribute to unravel the complex mechanism of succession in the herbivorous-carnivorous feeding behaviour of the larvae, and help in the development of new diet formulations.

The bacterial and fungal infections occuring in larval cultures can be treated successfully by various methods, such as antibiotic treatment or addition of herbicides respectively. This may however result in the development of resistant strains.

In the case of Penaeid shrimps, recent successes in the control of reproduction of captive spawning stocks open new possibilities. However, the culturing potential of the different species varies from one geographical area to another in regard to function of their ecological and physiological tolerances, as well as the prevailing local rearing technology.

The feasibility of large scale production of young Penaeid and Macrobrachium shrimp, as well as lobster, has been demonstrated repeatedly at several places. The present studies are now directed towards the economics of the culture. Cold water shrimps, such as Leander serratus are not yet produced on a large scale.

Studies on lobster ongrowing, which are carried out most intensively in North America, usually rely on highly sophisticated methods of individual rearing. An interesting new and promising approach to the problem of cannibalism, tested out at lab-scale, is based on social culturing with repeated sorting and restocking. Successes in hybrid production should soon help in estimating the survival chances of young lobsters released in the open sea.

3. Molluscs

The controlled reproduction and larval rearing of several species of molluscs is now common practice in experimental as well as commercial hatcheries of ICES member countries. The following bivalves can be quoted in this regard : Oysters (Ostrea edulis, Crassostrea gigas, C. virginica) and Clams (Mercenaria mercenaria, Venerupis decussata, V. semi-decussata).

The larval rearing of some other species, such as the Scallop (Pecten maximus), has not yet developed beyond the laboratory stage.

For the hatcheries, the possibility of storing deep-frozen algae opens new interesting perspectives, particularly with regard to the cost-benefit of commercial ventures. In order to assure a high water quality for the hatchery, the systematic use of antibiotics is still a common practice and new progress in ozonization techniques is opening interesting perspectives.

The problem of the transfer of the juveniles to the natural environment is presently receiving much attention. Nurseries, where the postlarval stages are grown under controlled conditions, eventually with controlled heating of the water with thermal effluents, are a most welcome intermediate step between the hatchery and the wild. Improvements of the phytoplankton mass production techniques are however still hampering the economic profitability.

4. CONCLUSIONS AND RECOMMENDATIONS.

4.1. Present status of knowledge.

When trying to list the different species presently cultured in hatcheries and nurseries, it appears that they can be classified in 4 different groups :

- Species, the larval rearing of which is technically possible, practiced, and commercially profitable on a large scale :

  Salmonids.
  Oysters (Ostrea edulis, Crassostrea gigas, maybe C. virginica).
  Macrobrachium rosenbergii.
  Penaeid shrimps (Peneaus japonicus, P. monodon).
  Red Sea Bream (Chrysophrys major).

- Species, the larval rearing of which is technically possible, practiced, but commercially risky on a large scale :

  Oysters (Crassostrea virginica).
  Clams (Mercenaria mercenaria, Venerupis decussata, V. semi-decussata).
  Abalones (Haliotis sp.)
  Penaid shrimps (Penaeus vanamei, P. stylirostris).
  Lobster (Homarus americanus).
  Sea Bass (Dicentrarchus labrax).

- Promising species for the near future (from both the technical and the commercial point of ~~vue~~) which are already produced in quantities exceeding several thousands :

  Scallops (Pecten maximus).
  Mullet (Mugil cephalus).
  Rabbitfish (Siganus rivulatus).
  Turbot (Scophthalmus maximus).
  Gilthead Sea Bream (Sparus aurata).
  Balck porgy (Mylio macrocephalus).
  Yellowtail (Seriola quinqueradiata).
  Sturgeon (Acipenser sturio).

- Possible species for the future. Either promising from the commercial point of views but with larval rearing still hardly successful (group A), or inversely hardly attractive from the commercial point of views although their larval rearing has been achieved on at least several thousand individuals (group B):

  group A : Milkfish (Chanos chanos), Eels (Anguilla spp.), Black Sea Turbot (Scopthalmus maeoticus), Lates sp, Tunas sp.

  group B : Plaice (Pleuronectes platessa), Herring (Clupea harengus), Cod (Gadus callarias).

4.2. Possible reasons for success

It goes beyond any doubt that the prime factors for success are both the economical feasibility of the operation and the market price of the cultured product. For example, the rearing of the Plaice (Pleuronectes platessa), is technically feasible but the prospect for a commercially profitable venture is so low that presently this species does not appear any more in aquaculture programs in the United Kingdom.

- With regard to success, it is clear that domination of the biological factors is an essential prerequisite.

After success at the lab-scale has been achieved, and before a large commercial venture is started, a pilot-scale operation should be set up which involves production of at least 100 tons of full grown animals.

In order to permit the development of family enterprises (the financial investments of which are limited) aquaculture facilities should be set up with governmental funding as transition phases, especially for those types of species the culturing of which implies different biological and/or technological steps.

4.3. Major gaps in the knowledge

Despite the research effort on live and fabricated foods this factor is still a bottle-neck for many aquacultural developments. Several biological and technological problems have to be solved yet in order to arrive at a better utilization, formulation and nutritional value respectively of the different types of food offered.

Whereas the physiology of reproduction has received much attention during the last years, only a few studies on the physiology of the larvae and juveniles seem to be available and this field of research should certainly be stimulated.

The use of thermal effluents, which is actively studied in the USA should be encouraged in other ICES member countries.

Last but not least major research areas in aquaculture where we are only at the pioneering stage are engineering, genetics and pathology.

4.4. Recommendations for researchers

Papers on larval rearing often suffer from a lack of fundamental information. The following minimum information should be given when relating experiments :

- Origin of the larvae : characteristics of the spawners and their stocking conditions, conditions of spawning and incubation, percentage of hatching, size of eggs or larvae.

- Food : quality and quantity of food offered, feeding technique, techniques of food production(compare also recommendations given by the WG at its second meeting, Coop. Research Report 65).

- Density : density of the food particles, density of the larvae.

- Abiotic factors : size, colour and shape of the containers; temperature; light (quality and intensity);aeration; water flow, oxygen; pH and if possible ammonia.

- Mortality : whenever possible, indication of the daily mortality is useful. In case of high mortality, possible diseases should be checked.

- Growth : information should not be restricted to the lenght of the animals, but also include weight, calculation of the condition factor, and whenever possible, the conversion efficiency.

5. INTERNAL MEETING

A list of participants is given in Appendix 5.

5.1. Proceedings and report

In a letter from the Director of COB to the General Secretary of ICES, CNEXO has offered to publish the proceedings of the meeting in full. The Working Group discussed this offer and was unanimously of the oppinion that all papers contributed should be published and consequently the offer of CNEXO be accepted. The papers shall, however, not be published prior to the 65th Statutory Meeting. Dr. Girin intends to carry 25 copies of a preprint to Reykjavik so that final decision can be made at the ICES Meeting: ~~there~~ if ICES would like to have this publication also under its name as suggested by the Working Group or if an independent publication by CNEXO is preferred.

It was also agreed that the papers should not be presented and discussed a second time at the 65th Statutory Meeting of ICES, but the report of the meeting should include their abstracts.

5.2. Patenting

The reports on the practices relating to the patenting of biological processes, with special regard to aquaculture, were available for Canada, Denmark, France, Germany (Federal Republic of), Ireland, Japan, Norway, The United Kingdom, the U.S.A., and Sweden. Other countries should provide their reports until the next meeting of the WG, meanwhile the reports already available should be updated.

The information in hand did not reveal any special regulation concerning aquaculture. It was decided that Dr. Dag Møller should be invited to further analyse the reports, and to give a report on his observations at the next meeting of the Group.

5.3. Information on other meetings and symposia

The chairman reminded the members of the Council resolution 1976/2:49 :

(1) At the special Mariculture session between the Fisheries Improvement and the Shellfish and Benthos Committees, and the Fisheries Improvement and the Anadromous and Catadromous Fish Committees at the 1977 Statutory Meeting, the special topic should be as follows : "The technology of mariculture systems with special reference to recycling and pollution control in salt water systems".

(2) The subject for the subsequent (1978) Statutory Meeting sessions between the Fisheries Improvement and the Shellfish and Benthos Committees, and the Fisheries Improvement and the Anadromous and Catadromous Fish Committees, should be as follows : "to study how the knowledge gained from the various disciplines studying mariculture can be used for the better management of fishery resources".

The chairman also drew the attention of the members towards the Symposium on Finfish Nutrition and Feed Technology, sponsored by EIFAC, and supported by ICES, in collaboration with GFCM and IUNS, to be held in Hamburg, from June 20 to 23 1978, with the following panels:

(1) Methodology of fish nutrition and technology.
(2) Fish nutrient requirements.
(3) Fish-husbandry feeding techniques.
(4) Fish-feed formulation and technology.
(5) Feed influence on product quality.
(6) Conclusions and recommendations.

Members were invited to inform the specialists concerned in their countries.

5.4. Future activities of the Working Group

The present meeting, with 37 experience papers, and nearly 100 participants and observers, widely exceeded the normal task of the Working Group, and it was feared that another meeting with presentation of papers would draw an even larger participation. It was therefore suggested that the problem would have to be discussed at the next Statutory Meeting of ICES. Is was furthermore suggested that a third meeting of the Working Group should be held in May 1978 in Bergen, Norway, to discuss "the utilization of thermal effluents for Mariculture purposes" over 2 days. A 3rd day should be used for demonstrations of aquaculture installations in Norway. For this purpose member countries and others interested should be invited to prepare detailed review papers about experiences with specific projects which are to serve as background information for the discussions. It is essential that specialists in the subject are coopted by their countries to attend and to promote in depth discussion of the subject.

6. APPENDIX

APPENDIX 1

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Appendix 2

Provisional Agenda

Open Session of Working Group

1) Opening of Working Group Meeting
2) Introduction of Meeting
3) Adoption of Agenda
4) Election of 4 discussion leaders and 2 rapporteurs (1 French, 1 English) for papers for Sessions I - IV.
5) Paper presentation and discussion for Sessions I - IV
6) Conclusions
7) Report
8) Close of Open Session

Internal Session of Working Group

9) Follow up of Open Session
10) Reports of members on the national practices relating to the patenting of biological processes
11) Special paper topics for Statutory ICES Meetings 1977 and 1978
12) EIFAC-Symposium on Fish Nutrition and Feed Technology
13) Topic for next Working Group Meeting
14) Other business
15) Close of Internal Session

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Appendix 3

Agenda of the Day

10.May	9^{00} - 12^{30} h	Agenda items 1 - 4 5, Session I
	13^{30} - 17^{00} h	5, Session II
11.May	9^{00} - 12^{30} h	5, Session III
	13^{30} - 17^{00} h	demonstrations
12.May	9^{00} - 12^{30} h	5, Session IV
	13^{30} - 17^{00} h	demonstrations
13.May	9^{00} - 12^{30} h	Agenda items 6 - 8
	13^{30} - 17^{00} h	9 - 15

Appendix 4

Paper contributions

SESSION 1

Marine fish species in general

1) C. E. Nash : The Breeding and Cultivation of Marine Fish Species for Mariculture.

2) V. Øiestad : Rearing of marine fish fry in ponds on the natural food production.

3) F.J. Gatesoupe et P. Luquet : Recherche d'une alimentation artificielle adaptee a l'elevage des stades larvaires des poissons. I. Comparaison de quelques techniques destinees a ameliorer la stabilite a l-eau des aliments.

27) P. Sorgeloos et al : The use of the brine shrimp, Artemia salina in aquaculture.

Marine flatfish

37) S. Kingwell : Large scale handling of larvae of the marine flatfish Turbot and Dover sole, with a view to their subsequent fattening under farming conditions.

4) M.Girin, R.Metallier et J. Nedelec : Accoutumance de jeunes soles (Solea solea) a differents aliments inertes apres achevement de la metamorphose.

5) M. Fonds & V.P. Saksena : The influence of temperature on daily food intake of young soles.

6) F.J.Gatesoupe , M.Girin et P.Luquet : Recherche d'une alimentation artificielle adaptee a l'elevage des stades larvaires des poissions. II. Application a l'elevage larvaire du bar et de la sole.

38) J.W. Adron and C.W. Cowie : Rearing of Plaice larvae to metamorphosis using an artificial diet.

SESSION 2

Marine Roundfish

7) M.H, Barahona-Fernandes and M. Girin : Effect of the food level on the survival and growth of laboratory reared Sea Bass (Dicentrarchus labrax) larvae.

8) E. Alliot, A.Pastoureaud et J. Trellu : Evolution des activités enzymatiques dans le tube digestif au cours de la vie larvaire du Bar, Dicentrarchus labrax. Variation des protéinogrammes et des zymogrammes.

9) R.Metailler, C.Mery, M.N. Depois et J. Nedelec : Influence de divers aliments composés sur la croissance et la survie d'alevins de bars (Dicentrarchus labrax)

10) E. Bedier : Les problèmes posés par l'application á grande échelle de techniques mises au point en laboratoire pour la production de juvéniles de bar (Dicentarchus labrax)

11) J. Kittaka : Red Sea Bream culture in Japan.

Anadromous and Freshwater Finfish

12) Y. Harache et al : Croissance et taux de survie de jeunes saumons Coho (Oncorhynchus kisutch Walbaum)aprés transfert direct en eau de mer pendant la premiefe année.

13) D. Piggins : Rearing salmon and rainbow trout for sea cages.

15) H. Hogendoorn : Progress in the controlled propagation of Clarias lazera (Couvier & Valenciennes)

SESSION 3

Penaeids shrimps and others

16) A. Laubier-Bonichon, A. van Wormhoudt et D. Sellos : Croissance larvaire contrôlée de Penaeus japonicus Bate:enzymes digestives et changements de régimes alimentaires.

17) D. Cognic : Relations entre l'élevage larvaire, le prégrossissement et le grossissement de crevettes Pénéides, à l'échelle d'une station de démonstration.

18) M. l'Herroux, R. Metallier et L. Pilvin : Remplacement des herbivores proies par des microparticules inertes. Une application à l'élevage larvaire de Penaeus japonicus.

19) AQUACOP : Maturation et reproduction de crevettes Peneides en captivite 2

20) AQUACOP : Elevage larvaire de crevettes Peneides.

21) J. Kittaka : Recent progress of penaeid shrimp culture.

36) P. Richard et H.J. Ceccaldi : Etude de quelques paramètres biochimiques au cours du développement embryonnaire de Palaemon serratus.

22) AQUACOP : Elevage larvaire de Macrobrachium Rosenbergii en milieu tropical: unite pilote.

23) A.F. Eble et al : Maintenance of brood stock, larval rearing and nursery techniques used to grow Macrobrachium Rosenbergii in wasteheat discharge waters of an electric generating station in New Jersey (USA).

Lobsters and Crabs

24) J.Y. le Gall et al : Croissance et survie du homard (Homarus vulgaris) pendant les quatre premiers stades en elevage et sous alimentation composee.

25) J.M.Carlberg and J.C. Van Olst : Methods for culturing the American lobster, Homarus americanus

40) J.D. Castell : Development of techniques for larval and juvenile lobster culture for use in lobster nutrition studies.

41) D. Aiken : Techniques for mass rearing juvenile lobsters (Homarus americanus).

26) R.A. Shleser : Crustacean culture at the Bodega Marine Laboratory (Homarus americanus, Cancer magister).

SESSION 4

Gastropods

28) J.P. Flassch et E. Woitelier : Action d'algues phytoplanctoniques sur la métamorphose et la croissance post-larvaire de l'ormeau, Haliotis tuberculata.

29) J.P.Flassch et J.Mazurie withdrawn : Détermination de la ration alimentaire chez le juvénile d'Haliotis tuberculata en élevage intensif.

Bivalves

30) J.C. Dao et D. Buestel : La production de juvéniles de coquille St-Jacques, Pecten maximus L.

31) A. Lucas : La culture de la palourde japonaise, Venerupis semi-decussata, à partir de naissain d'écloserie.

32) AQUACOP : Reproduction et elevage larvaire de Crassostrea gigas en milieu tropical.

39) T. Rowell withdrawn : Growth and mortality studies in off-bottom larval oyster (Crassostrea virginica) culture rearing.

33) G.D.Pruder, E.T. Bolton and C.E. Epifanio : Hatchery techniques for controlled environment molluscan mariculture.

42) Y. Leborgne : L'écloserie-nurserie de la SATMAR et les possibilités actuelles de production de naissain de mollusques bivalves.

34) R. Ukeles : Culture of algae for feeding larval and juvenile molluscs in controlled aquaculture.

General

35) W.J.Blogoslawski: Ozone as a disinfectant in mariculture.

Appendix 5

List of participants of internal session

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