Workshop Discussions and Recommendations

The discussions on fish breeding focused on problems related to breeding marine and freshwater species that are economically important in the Philippines and Southeast Asia. Workshop discussions on seed production evolved around common problems encountered in rearing larvae of these species. Recommendations to address these problems are summarized and will be useful guides in planning future research on breeding and artificial propagation of economically important fish species at the SEAFDEC Aquaculture Department as well as in other research institutions and universities in the Philippines and Southeast Asia.

Fish Breeding

Grouper

Since groupers are protogynous hermaphrodites, the lack of wild-caught males and length of time needed to develop males from captive stock are major problems in breeding groupers. Size may be an important factor in natural sex-inversion (the largest fish in the stock spontaneously inverts to males), however, the possibility that primary males may naturally occur at least for some species should be considered.

There is yet no standard technique for inducing sex-inversion in grouper. Sex-inversion of females has been induced through dietary administration or injection of methyltestosterone. Sperm quality of the sex-inversed males is apparently poor. Work on other species (e.g. ricefield eel, bluehead wrasse) indicated that gonadotropin-releasing hormone (GnRH) is important in inducing sex-inversion and protocols using combinations of GnRH, testosterone, and a dopamine antagonist may be effective. A preliminary study to investigate the influence of social hierarchy on sex inversion in immature *Epinephelus suillus* gave no indication that social factors can induce spontaneous sex-inversion in captive stocks. Scanty information is available on natural histories. Fishermen are also not aware of the proper methods of capture and handling of wild adults that can be a potential source of broodstock.

Snapper

Captive broodstock that matured in captivity can be induced to spawn using human chorionic gonadotropin and a luteinizing hormone-releasing hormone analogs. (Editor's note: natural spawning among the breeders recently occurred).

In: Marte CL, Quintio GF, Emata AC (Eds.). 1996. Proceedings of the Seminar-Workshop on the Breeding and Seed Production of Cultured Finfishes in the Philippines. 4-5 May 1993, Tigbauan, Iloilo, Philippines. SEAFDEC/AQD, Tigbauan, Iloilo, Philippines. p. 177-182.

Very limited information, however, is available on the life history and reproduction of snappers.

Milkfish

As broodstock naturally spawn in captivity, the discussion centered on broodstock nutritional requirements that will ensure good egg and larval quality. A SEAFDEC/AQD formulated broodstock diet containing 36% protein and 6% lipid improved the quality of spawns and enhanced mass production of fry. The diet may be improved further as information on requirements of breeders for other nutritional factors (i.e. vitamins and trace metals) become available.

Tilapia

The main problem besetting the tilapia industry in inadequate supply of fry. Specific problems identified relate to husbandry and species characteristics such as hybridization, and breeder size.

While production of all male tilapia fry through hormonal induction is being commercially practiced, current research focus on production of genetically all-male tilapia (YY males or super males). Experimental production of all-male fry has been successful, however, it is not yet feasible to try this under farm conditions since the procedure is complicated. Efforts are focused to generate genetically-altered broodstock for farm production of genetically all-male tilapia.

Aggressive behavior among tilapia during spawning is marked when crowding and size differences between the sexes are great. The use of similar-sized breeders, provision of adequate rearing space, and longer association of breeders can minimize aggressive behavior. Environmental, hormonal, or dietary treatments may be used to synchronize spawning, increase spawning frequency and egg production in tilapia and other species but fuller understanding of reproduction and other physiological processes is needed before interventions can be applied.

Mullet

While mullets are generally considered good candidate species for culture, little work has been done to develop or adopt breeding and seed production technologies for these species. In addition to *Mugil cephalus,* other species such as *M. dussumieri* and *Liza vagiensis* are potential candidates for culture. Except for *L. vagiensis* whose fry can be easily identified, difficulty in identifying wild-caught fry of fast growing mullet species has not encouraged their culture.

Seed Production

Egg quality

A standard set of criteria to effectively assess quality (defined as those characteristics which determine the capacity to survive) of spawned eggs is still lacking. Criteria such as buoyancy and transparency of eggs, level of nutrients such as highly unsaturated fatty acids (HUFA) and free amino acids, and hormones such as thyroxine (T_4) and tri-iodothyronine (T_3) may be used but little and sometimes conflicting information is available on how levels of these factors affect the egg and larval quality. Criteria for freshwater and marine fish and for euryhaline and stenohaline fish also may differ. For instance, stenohaline fish may require high levels of HUFA whereas euryhaline fish may not, and strictly marine fish require T_3 more than T_4 whereas the reverse is true for freshwater species. However, there is an urgent need to develop a reliable method of assessment, and to be of practical use to hatchery operators, must be simple to perform and carried out at an early phase of larval rearing to immediately eliminate poor quality or unproductive batches of eggs.

Transport and Handling

Loading densities of eggs or yolk-sac larvae for transport vary (6,000/1, milkfish; 10,000/1, sea bream; 12,000/l, grouper; 100,000/l-200,000/l, sea bass) and are well established for each species. High mortality rates of transported eggs and larvae, and incidence of abnormalities may be related to time and method of collection (embryonic stage), duration and mode (land or air) of transport and other factors that need to be determined.

Hatchery Techniques

There is also species variations in stocking densities for rearing fish larvae. In general, cannibalistic species are reared at low densities particularly during the latter rearing phase, and even for non-cannibalistic species such as milkfish, larval survival is higher at lower stocking densities. Cannibalism among older larvae, however, may be minimized by continuous feeding.

Live food of the appropriate size adequate nutrient content and at high densities is introduced prior to mouth opening to ensure its availability. Artificial feeds may be introduced as soon as larvae have developed the capability to digest complex nutrients. This occurs at later stages of larval development (e.g. day 25 sea bass larvae). Information on the development of digestive tract, occurrence of digestive enzymes and nutritional requirements of specific species are needed if artificial feeds are to be fed to larvae. Growth enhancers such as anabolic steroids (e.g. methyltestosterone) may also be incorporated. Hormones involved in

metamorphosis such as T_3 or T_4 of fish larvae may also be tried but appropriate hormone/s doses, and methods of administration, should be determined to prevent incidence of detrimental effects (mass mortalities, deformities).

To ensure highest quality of hatchery-produced fry, sensitive tests (e.g. thermal, salinity, and handling shock tests) may be applied. However, tests must be developed for each species since response to these tests will differ among species. As mentioned earlier, these tests must be simple to perform and conducted at the early rearing phase to reduce hatchery production cost.

There is a general perception particularly among milkfish farmers that hatchery-produced fry are weaker or grow poorly compared to wild-caught fry. Different batches of fry also differ in growth and survival when grown under similar pond conditions suggesting inconsistent fry quality between batches. Similarly, hatchery-produced sea bream fry intended for release in open water are weak compared to wild fry. Compared with wild fry which have survived adverse conditions, the inability of hatchery-produced fry to compete for food in grow-out ponds or in open waters may be due to its previous exposure to "comfortable" hatchery conditions. Techniques to improve survival of hatchery-bred fry particularly those species intended for sea ranching are therefore wanting.

Broodstock Management

In-breeding has been cited as a major cause of the deterioration of fry quality in tilapia and bighead carp. Thus, broodstock management techniques that can reliably maintain genetic diversity of captive stock have to be developed.

Recommendations

General Recommendations

* Studies on the nutritional requirements of broodstock to develop improved diets.

* Induction of sexual maturation and spawning by pituitary extracts to improve the quality of spawned seed.

* Development of a reliable criteria for evaluating egg and larval quality for each species.

* Refinement of egg transport techniques particularly for prolonged transit time.

* Studies on larval nutrition and refinement of larval feeding techniques.

* Compare quality of hatchery-bred and wild-caught fry; of induced-spawned and naturally-spawned eggs and larvae.

Grouper (*Epinephelus* sp.)

* Manipulation of social (e.g. size hierarchy) and hormonal factors to induce sex-inversion.

* Habitat requirements, breeding cycles, life histories including age at sexual maturation and sex-inversion.

* Stock assessment and development of capture methods for wild breeders.

* Improvement of fry capture and transport methods.

Milkfish (*Chanos chanos*)

* Improvement of feed formulation for broodstock.

* Dissemination of the existing broodstock feed formulation for production by private entrepreneurs.

Snappers (*Lutjanus* sp.)

* Stock assessment of wild snappers.

* Studies on reproductive biology and life history.

Sea bass (*Lates calcarifer*)

* Improvement of nursery techniques.

Rabbitfish (*Siganus guttatus*)

* Improvement of hatchery and nursery techniques.

Mullet (*Mugil* sp., *Liza* sp.)

* Assess potential of suitable mullet species for culture.

Tilapia (*Oreochromis* sp.)

* Develop broodstock management techniques to maintain genetic diversity of stock.

* Homonal, environmental, and dietary manipulation to synchronize spawning of broodfish.

* Establishment of germplasm bank.

* Dissemination of culture methods for "superior" strains through extension work.

Catfish (*Clarias macrocephalus*)

* Determine ecological impact of introduced species (e.g. African catfish).

Bighead carp (*Aristichthys nobilis*)

* Genetic improvement of in-bred local broodstock.

Freshwater and Marine Ornamental Fish

* Develop broodstock and seed production methods.