# SUMMARY AND CONCLUSIONS

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The opening paper given by Dr. Haller discussed Florida's aquatic weed problems, and interest in grass carp. Grass carp are being evaluated in Florida primarily as a control agent for hydrilla (Hydrilla verticillata) which was introduced during the early 1960's. By 1967 hydrilla was established in approximately 2,000 ha, and by 1977 was found in freshwaters totaling near 250,000 ha. Dr. Haller emphasized the importance of establishing control methods that are not degrading to the environment and methods that will not harm Florida's sport fishery which is a sizable industry.

Dr. von Zon (Holland) stated that aquatic plant control could be achieved by methods based upon the following principles: growth prevention, retardation and cessation. In this meeting we have been concerned with and discussed grass carp as a bio-control agent. The grass carp, according to von Zon, encompasses all three methods as there is a progressive retardation of weed growth, which causes growth to stop and finally weeds are harvested. He stated that the plant control method utilized should be adjusted to each situation and user group and that plant erradication was not advocated. In Holland, grass carp control vegetation more cheaply than either chemical or mechanical control methods and if utilized correctly can achieve more permanent control than the other methods, however, the control is not nearly as fast. He continued by stating that grass carp may be unfairly evaluated, as the chronic effects of other control methods (chemical and mechanical) have not been studied. He concluded that the side effects were less severe using grass carp and less irreversible than chemical methods.

Mr. Ware of the Florida Game and Fresh Water Fish Commission expressed great concern over the use of grass carp for vegetation control in Florida waters. This concern is based on the fragility of aquatic ecosystems and he used Lake Apopka in Central Florida as an example. This large lake, because of largescale removal of the vegetation and other environmental changes is characterized by continued phytoplankton blooms. His concern is for the maintenance of good sport fish populations in Florida lakes and feels that indiscriminate removal of aquatic weeds from these systems will degrade the sport fishery.

Other speakers expressed optimism concerning the grass carp as a bio-control organism. According to Mr. Henderson, Arkansas utilizes the fish routinely for vegetation control and has not seen adverse effects from its usage.

Mr. Stott stated that Great Britain has guarded optimism concerning grass carp, but it is potentially useful for weed control and could be used in conjunction with approved herbicides. Although the environmental impact of the fish is not fully understood, the risk of permanent damage to waters in Great Britain is slight because it is doubtful that natural reproduction will occur. He suggested that more large-scale trials should be attempted by local authorities in his country in order to more fully evaluate the fish.

Consideration should be given to the area into which grass carp are stocked. The paper presented by Miley et al. addressed this problem. Grass carp were stocked into four Florida lakes ranging in size from 5 to 30 acres. Adverse effects to native fish populations were noted in two sparsely vegetated ponds, whereas in a third pond that contained considerable amounts of submerged vegetation (hydrilla) and a large residual grass carp population, a viable sport fish population still existed at the termination of the study. It is unfortunate that base line fishery data was not collected for this pond. The authors concluded that grass carp should not be stocked in ponds containing "normal" or sparse vegetation.

Natural reproduction of grass carp was discussed by several speakers. Stanley, Sutton and Miley summarized a recent European trip. They reported that grass carp reproduced naturally in Russian rivers, but made up a small percentage of the fishes occurring in these rivers. Russian researchers noted, however, that northern pike (Esox lucius) and yellow perch (Perca fluvialtilis) were eliminated in one pond heavily stocked with grass carp. Dr. Haller visited Asia and reported the findings of his trip. Grass carp are reproducing in the Tone River, Japan and apparently reproduced one year in the Ah Tien Reservoir on Twain, natural reproduction has not occurred subsequently in this reservoir. Although Dr. Haller did not visit the Phillipines, another member of the group (Mr. William Bailey) visited the Panpanga River. It was not definite as to whether grass carp reproduced in this river. Mr. Leslie discussed the probability of natural grass carp spawning in Mexico. A trip was made to Mexico by Florida Department of Natural Resources personnel and the conclusion was that grass carp had spawned in the Rhio Balsas River. Dr. Tsuchiya discussed natural grass carp reproduction in the Tone River, Japan. He indicated that the construction of wiers (dams) has changed the spawning site of grass carp and that silver carp now make up a greater percentage of the reproducing Chinese carp populations. The change in composition was due to more favorable conditions for silver carp survival.

From the above discussions it was concluded that the following conditions are necessary for natural reproduction: (1) Adult fish must be in good physiological condition; (2) Water temperature must be above 18 - 19 C; (3) Water velocity must be above 0.8 m/sec; (4) Turbulence near the spawning site is necessary; (5) The river must be at least 50 km long; (6) Fry and fingerlings must have a food source near where hatching occurs; (7) Turbidity increases might be necessary and stimulate spawning through light intensity; and (8) A rise in water level usually precludes spawning which might influence water quality, making conditions more suitable for spawning.

Dr. Tsuchiya also discussed grass carp spawning techniques used at their stations; adult fish over five years of age weighing 5 - 20 kg are used.