CONCLUSIONS

SERI 2011 SPECIAL MARINE RESTORATION SESSION

Organizer and Chairperson
Thomas J. Goreau, PhD

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SESSION I

1. Lee Ann Beddoe, et al., **ELECTRICAL FIELDS INCREASE CORAL GROWTH IN TOBAGO**
Corals in low voltage electrical fields grew much faster than normal in a very poor water quality environment in which control corals died back. Shutting the power off caused them to lose weight, and they immediately continued rapid growth when power was restored. This demonstrates that electrical fields greatly accelerate coral growth, and that this is a direct result of the current, with no residual effect.

2. Jamaluddin Jompa, et al., **ELECTRICALLY STIMULATED CORALS IN INDONESIA REEF RESTORATION PROJECTS SHOW GREATLY ACCELERATED GROWTH RATES**
Three different coral species on three different islands (Bali and two islands off Sulawesi, Indonesia) grew 2-4 times faster under electrical stimulation than controls, with stimulation decreasing under lower current and greater depth. This indicates strong potential of electrical stimulation for restoring damaged coral reefs.

3. Ilham Alimin, et al., **BIOROCK TECHNOLOGY INCREASES CORAL GROWTH AND FISH ASSEMBLAGES**

Electrically stimulated corals in Lombok, Indonesia, grew 4-6 times faster than control corals, with lesser stimulation at greater depths. Fish populations were 6 times greater in Biorock reefs than control reef sites. The projects have stimulated reef restoration in a devastated area.

4. Khalid Abdallah, et al., **ELECTRICAL CURRENTS STIMULATE CORAL BRANCHING AND MAINTAINING GROWTH FORMS**

Corals growing in severely polluted waters near Jakarta, Indonesia, grew faster under electrical stimulation, and the rate of budding and branching was even more elevated, although this was a function of colony shape. Electrical stimulation may accelerate tissue growth more than skeleton growth.

5. Jens Nitzsche, et al., **ELECTRICITY PROTECTS CORAL FROM OVERGROWTH BY AN ENCRUSTING SPONGE IN INDONESIA**

Sponges growing on electrified substrates had growth depressed, while corals were stimulated in the surrounding areas. Increased current acted to suppress sponge overgrowth of corals. High sponge abundance on the structures is therefore likely due to elevated settlement in the electrical field.

6. Susanna Strömberg, et al., **TESTING THE SUITABILITY OF MINERAL ACCRETION FOR COLD-WATER CORAL REEF HABITAT RESTORATION**

Cold, deep water corals from the North Sea showed higher rates of budding and branching under low rates of electrical stimulation. This suggests potential for restoring deep water reefs damaged by fishing and oil and gas drilling.

SESSION II

7. Prawita Tasya Karissa, et al., **UTILIZATION OF LOW VOLTAGE ELECTRICITY TO STIMULATE CULTIVATION OF PEARL OYSTERS *PINCTADA MAXIMA* (JAMESON)**

Pearl oysters grew faster and reached maturity earlier under electrical stimulation and juvenile oysters showed higher settlement and survival on electrified limestone substrates. These results indicate potential mariculture applications.

8. Nikola Berger, et al., **HIGHER OYSTER GROWTH AND SURVIVAL WITH ELECTRICAL STIMULATION**

North American oysters grown on electrified substrates in flow through tanks in New York City showed much higher growth rates and survival than controls.

Such methods could be used to restore oyster reefs and improve water quality in estuaries.

9. Jason Shorr, et al., **ELECTRICAL STIMULATION GREATLY INCREASES OYSTER SURVIVAL IN RESTORATION PROJECTS**
Oysters cultured in the field on electrified substrates in New York City had higher growth and survival in a severely polluted habitat where control oysters died. This indicates the potential of restoring oyster populations even under extremely poor conditions.

10. Mara Haseltine, **SUSTAINABLE REEF DESIGN TO OPTIMIZE HABITAT RESTORATION**

Artificial reefs can be designed to optimize flow of water to supply food and remove wastes, thereby greatly accelerating the growth of organisms and the ecological services they provide.

11. James Cervino, R. Vaccarella, et al., **ELECTRICAL FIELDS GREATLY INCREASE SALTMARSH AND SEAGRASS GROWTH AND SURVIVAL AND SPEED RESTORATION EVEN IN ADVERSE CONDITIONS**
Electrical fields greatly increased seagrass growth, survival, and establishment on rocky bottom at both clean and polluted sites in the Adriatic Sea. This showed potential for restoring seagrass beds lost due to wave erosion for stabilizing shorelines. Saltmarsh grass at a severely polluted site in New York City had about double the growth rate and more than 20 times the winter survival than controls. It was possible to grow saltmarsh grass deeper in the intertidal than its normal range, which could be used to extend saltmarshes seaward and protect eroding coasts, for example in Louisiana.

12. Gilles Lecaillon, **FISHERIES RESTORATION BY POST LARVAL RESTOCKING**

Post larval fish capture and culture collects freshly metamorphosed juvenile fish and raises them, short-circuiting the predation that would eliminate almost all of them before they can find shelter. The full range of species and genetic diversity is preserved, and the resource is not depleted. Raising these fishes in suitably restored juvenile fish habitat will provide the fastest way to restore coastal fisheries.

13. Tom Goreau, et al., **RESTORING REEFS TO GROW BACK BEACHES AND PROTECT COASTS FROM EROSION AND GLOBAL SEA LEVEL RISE**
Coral and oyster reefs provide the best beach and shore protection, but are rapidly vanishing. Biorock technology allows the growth of self-repairing limestone reefs of any size or shape, using renewable energy, at a much lower cost than conventional methods, and with much greater environmental benefits. By growing Biorock reefs in front of eroding beaches it has been possible to grow

back severely eroding beaches in a few years. The method can be used to protect coastlines threatened by global sea level rise and grow artificial islands.

14. Tom Goreau, **MARINE ECOSYSTEM ELECTROTHERAPY: THEORY AND PRACTICE**

Electrical fields in the right range greatly stimulate the growth and survival of marine organisms, healing from physical damage, and greatly increases their resistance to severe environmental stress. This makes these methods the best practice for restoring destroyed or damaged marine ecosystems, especially in the face of globally increasing temperature, sea level, and pollution. The effects are due to the greater supplies of biochemical energy resulting from the biophysics of the electrical field.