CSD-15 Partnerships Fair
Interactive Discussion Session

SIDS Partnership: Implementation of New Technologies for Sustainable Development

Monday, 7 May 2007, 3:00-6:00 PM, Conf. Room 7

BIOROCK TECHNOLOGY FOR CORAL REEF RESTORATION, FISHERIES RESTORATION, & MARICULTURE IN SIDS

BIOROCK® TECHNOLOGY

The most cost effective solution for:

Coral Reef Restoration

Fisheries Restoration

Shore Protection

Mariculture

Materials Production

Dr. Thomas J. Goreau

President

Global Coral Reef Alliance

CORAL REEFS ARE THE MOST DIVERSE, PRODUCTIVE ECONOMICALLY VALUABLE, AND BEAUTIFUL MARINE ECOSYSTEMS

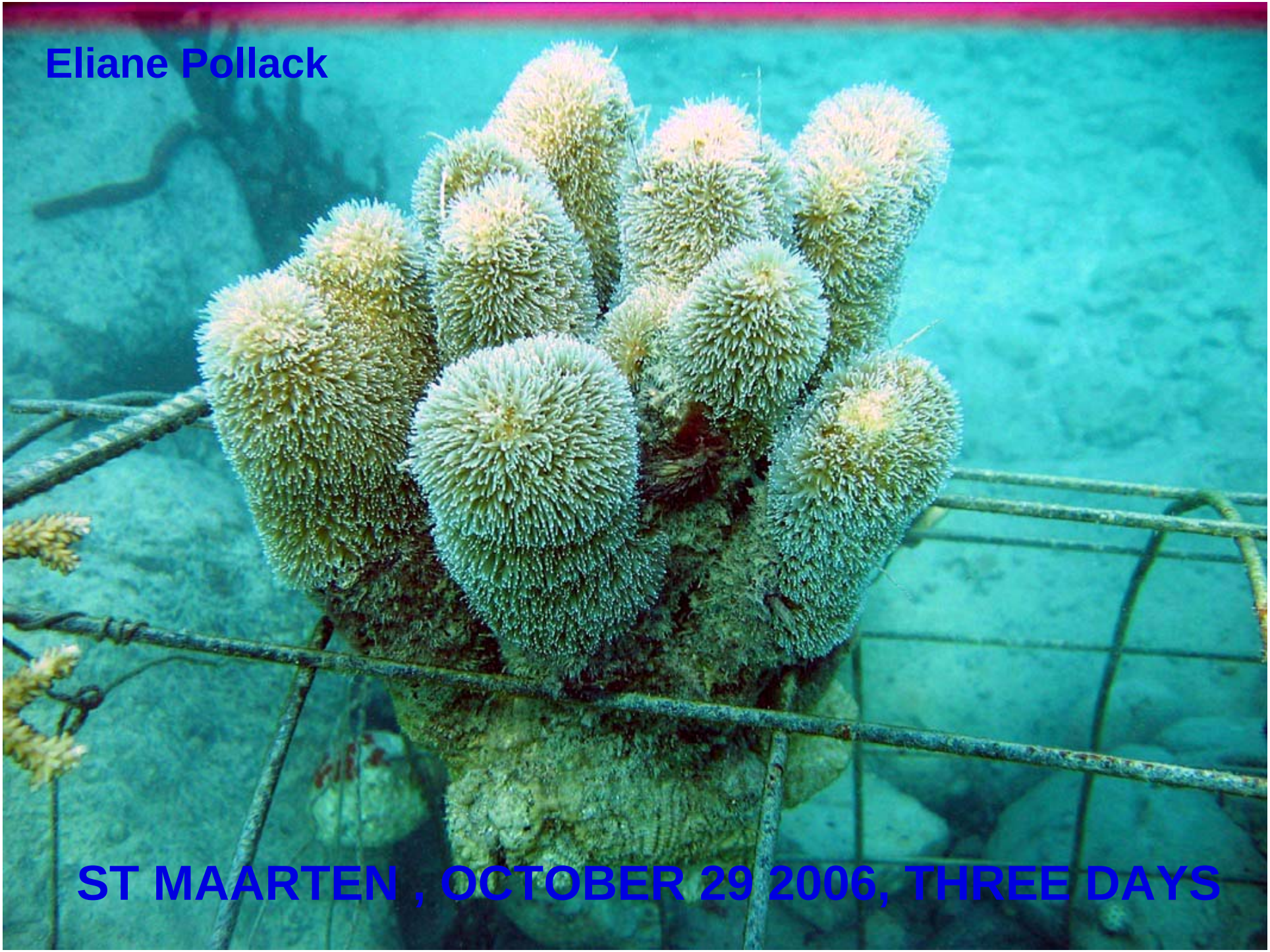
BAHAMAS, 1948
F. W. GOREAU

A solution for corals in peril

Electric Reefs

ST MAARTEN , OCTOBER 29 2006, THREE DAYS

Eliane Pollack


Eliane Pollack
ST MAARTEN , OCTOBER 29 2006, THREE DAYS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ST MAARTEN , OCTOBER 29 2006, THREE DAYS

OCTOBER 31 2006
ST. MAARTEN
1 WEEK

Eliane Pollack


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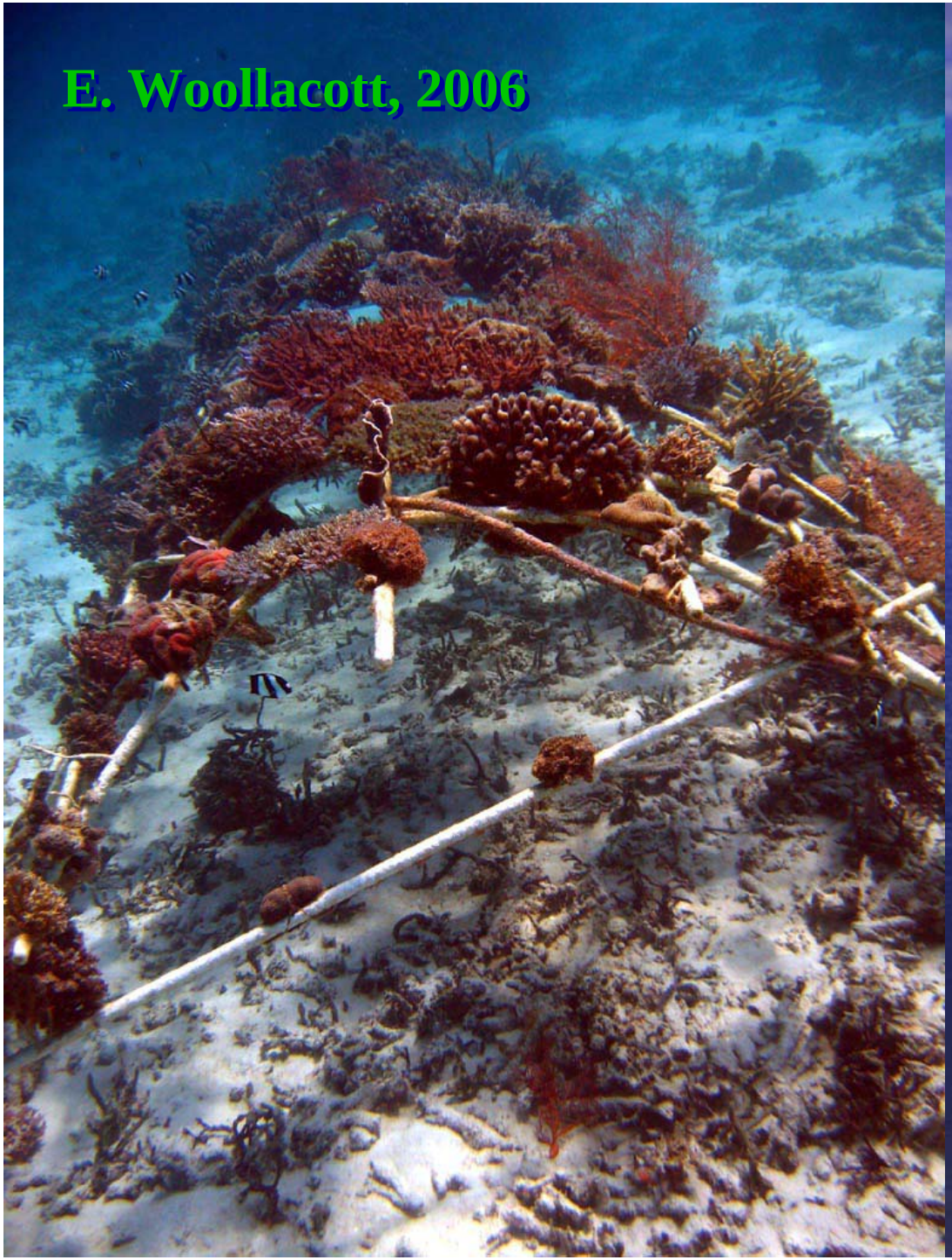
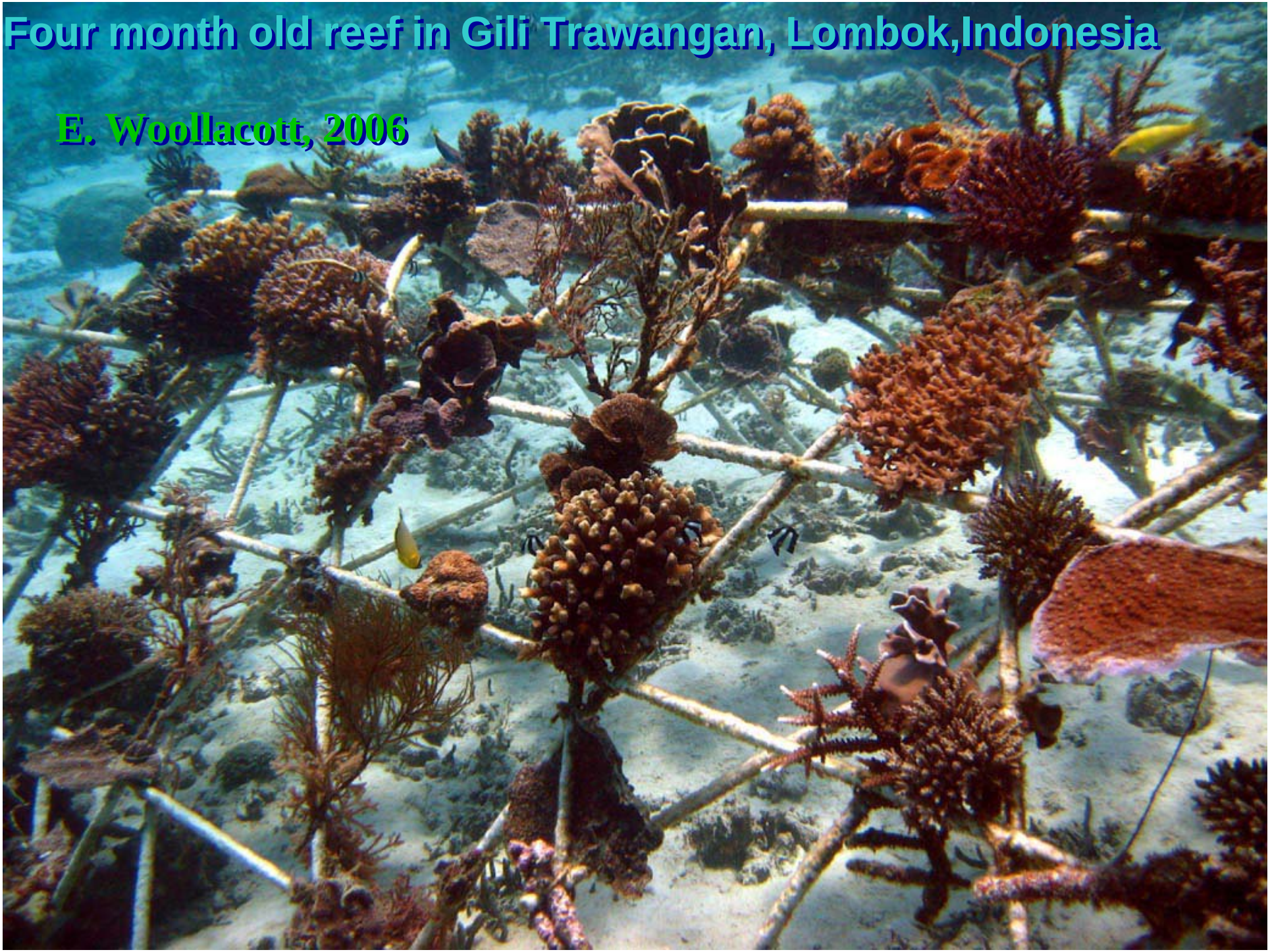
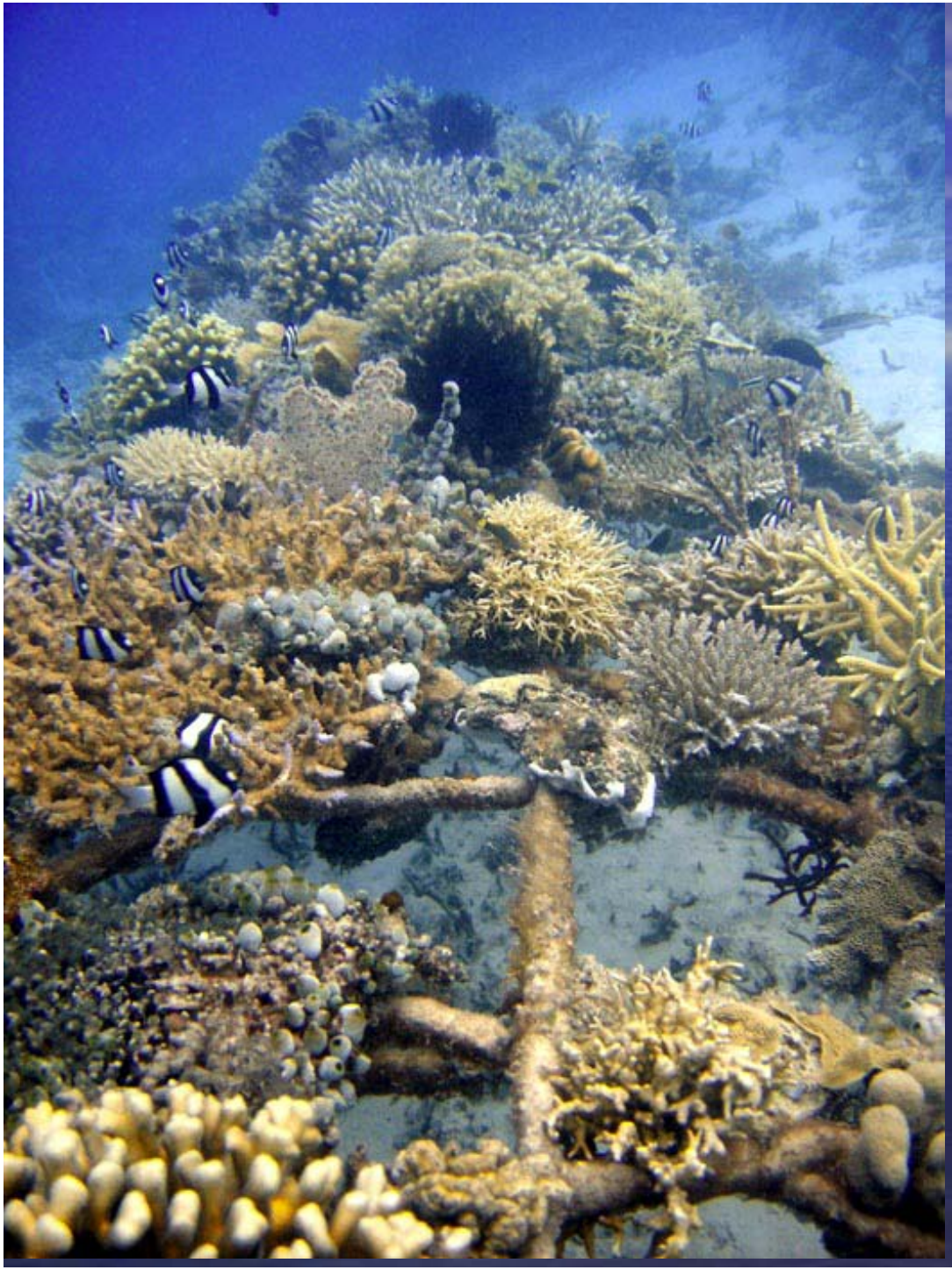


Four month old reef in Gili Trawangan, Lombok, Indonesia

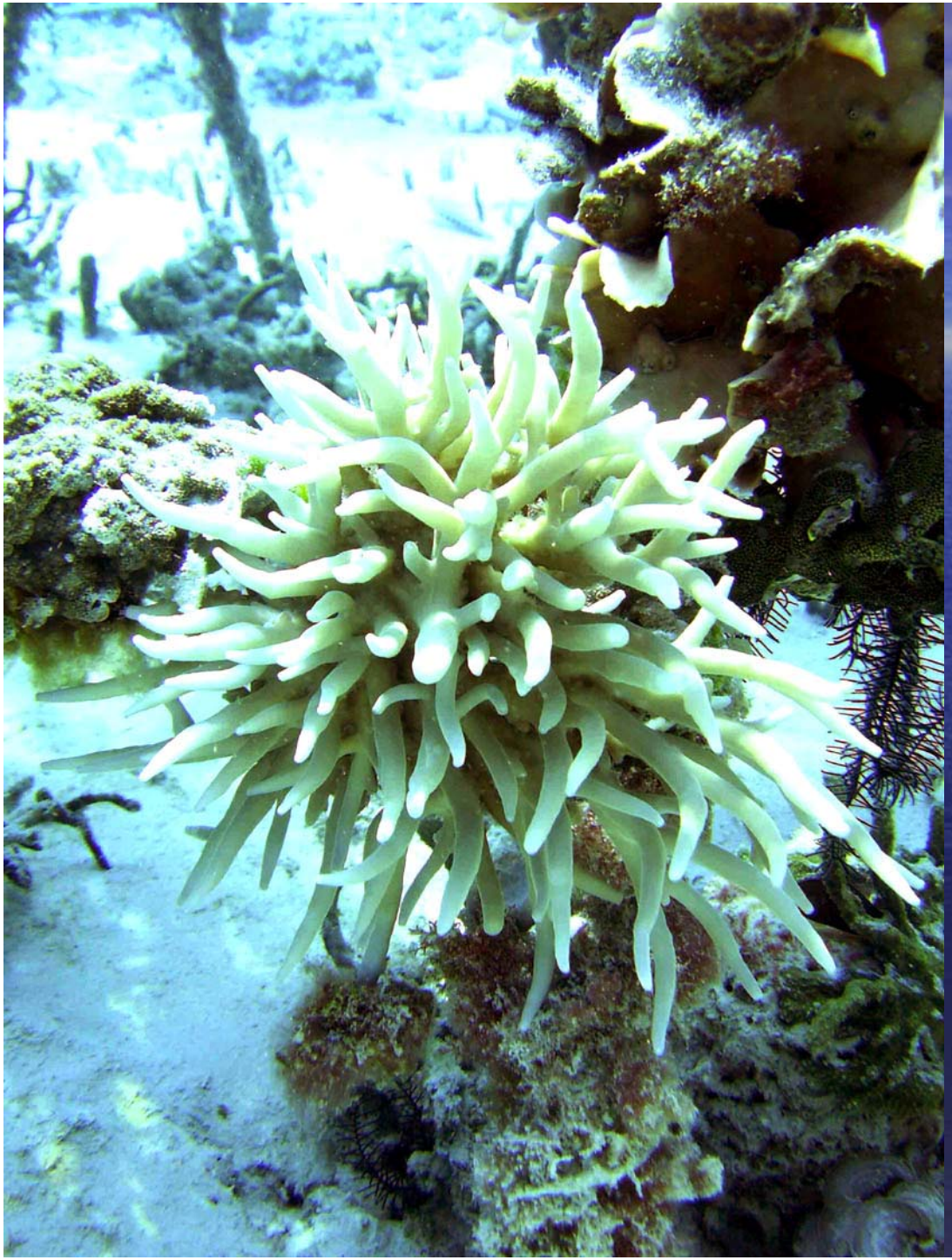

Four month old reef in Gili Trawangan, Lombok,Indonesia
E. Woollacott, 2006



August 2006
9 months old

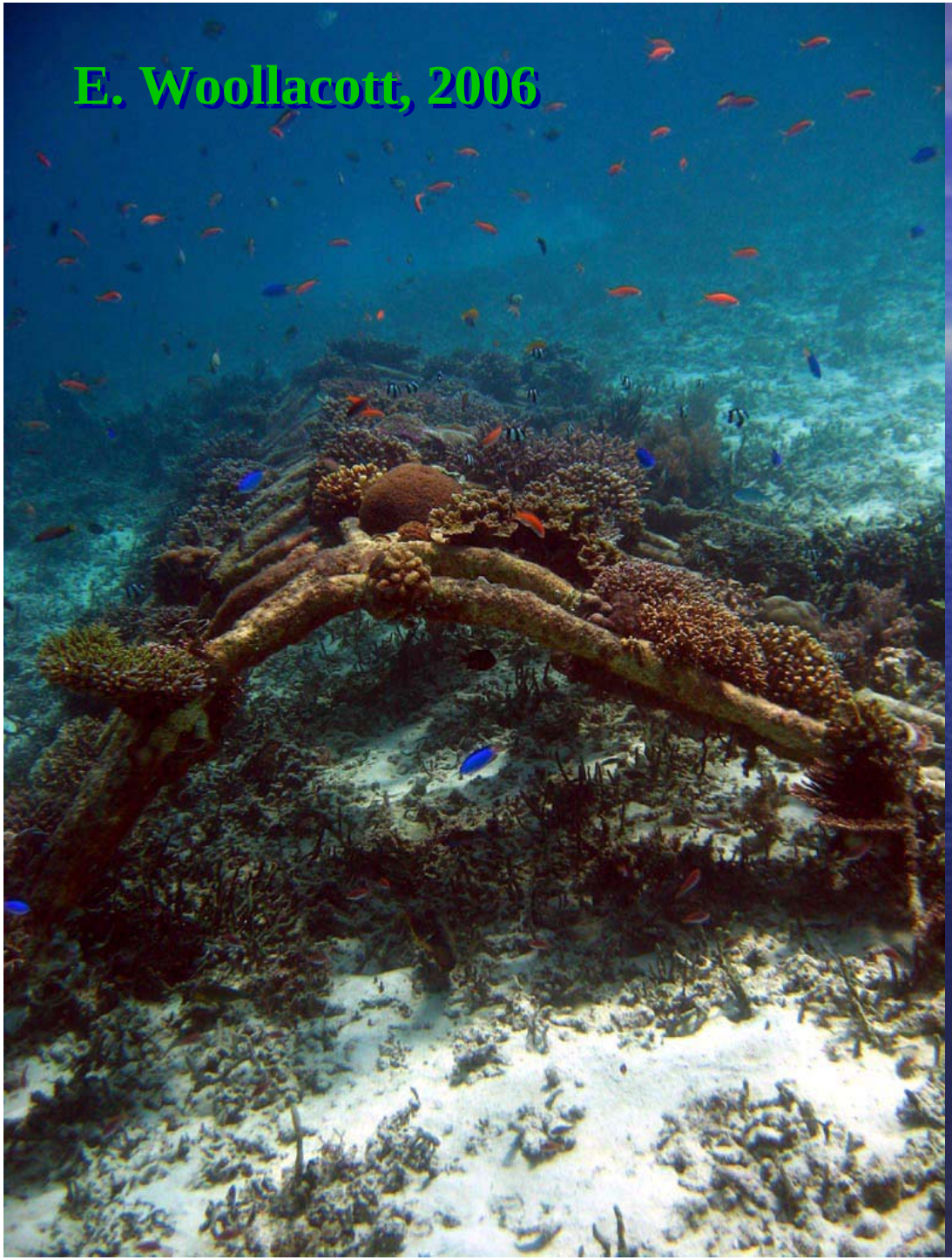
Laurent Lavoye

Gili Trawangan



10 month coral

Chris Hendricks
Gili Trawangan
September 2006



1.5 year old reef in Gili Trawangan, Lombok, Indonesia

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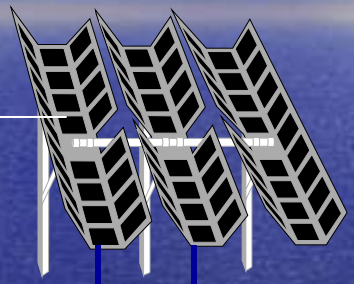
3 year old Biorock reef, Ibu Karang,
Pemuteran,Bali, Indonesia
J. Cervino 2004

How a Biorock® Reef works

When a positively charged anode and a negatively charged cathode are suspended in sea water with an electric current flowing between them, calcium ions combine with carbonate ions and adhere to the structure (cathode).
The result is calcium carbonate. Corals adhere to CaCO3 and grow quickly.

Power can be solar, wind, tidal, or AC powered chargers

Solar collector or other power supply



Anode (+)

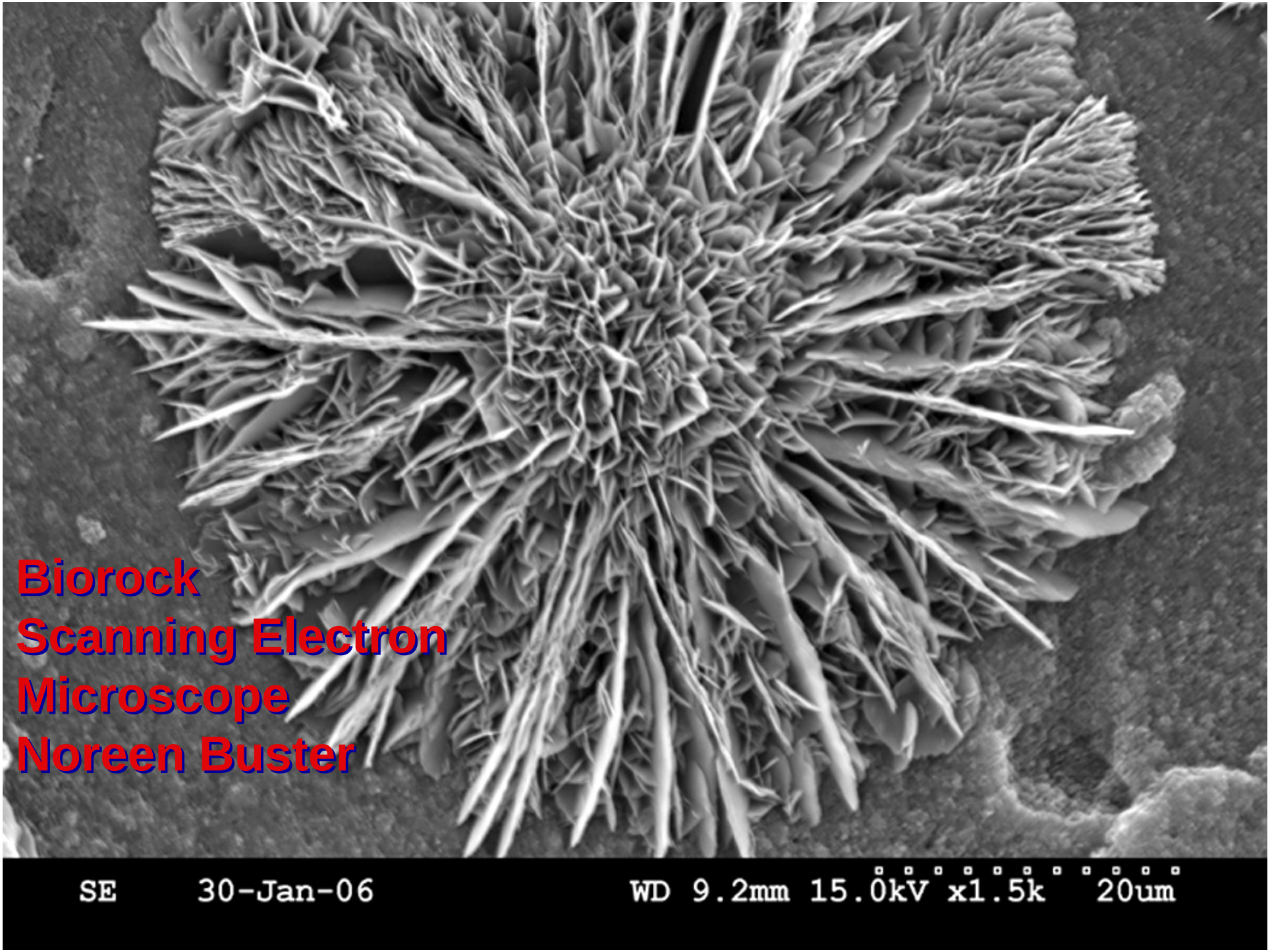
Cathode (-) Conductive Structure

(CaCO3)

Coral Fragments

Biorock®/ Mineral Accretion

- On underwater, conductive structures we assemble a positively charged anode and a negatively charged cathode (structure)
- Apply a low voltage electric current between them
  - Safe for swimmers
- Which causes minerals to crystallize from seawater onto structures
- Calcium carbonate, white limestone ($CaCO_3$) is formed-Similar to natural coral reefs and tropical white sand
- Corals adhere to limestone and grow quickly


Biorock
Scanning Electron
Microscope
Noreen Buster
SE 30-Jan-06 WD 9.2mm 15.0kV x1.5k 20um

4 year old
Biorock reef,
Goa Karang,
Pemuteran, Bali,
Indonesia

3 year old Biorock reef, Pemuteran, Bali, Indonesia


3 year old Biorock reef, Nautilus, Pemuteran, Bali, Indonesia
J. Cervino 2004

How to build an electric reef

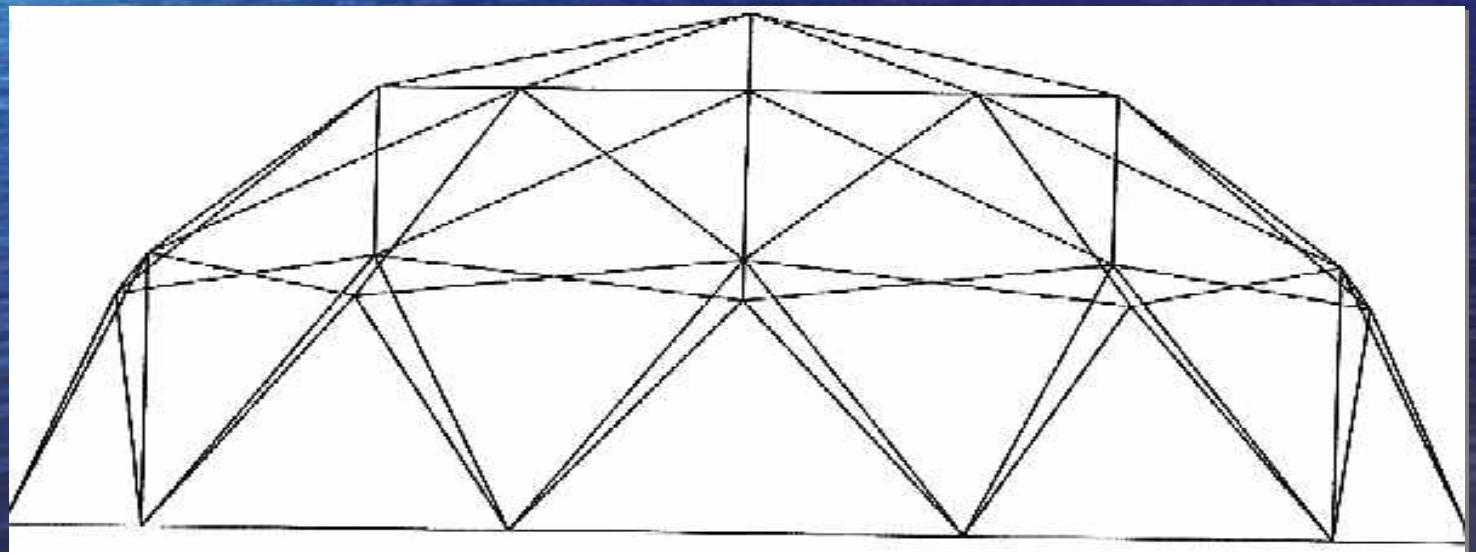
- Design the structure
- Assemble the structure from conductive materials
- Submerge the structure
- Attach anode material
- Attach wires from solar panel or power supply
- Turn on current
- Watch for bubbles
  - Signifies limestone forming
- Attach coral fragments
- Watch the coral grow
- See the fish and all other forms of reef life attracted

2 year old Biorock reef, Karang Lestari, Pemuteran, Bali, Indonesia

J. Cervino 2004

Designing a structure

- Designs take into account depth, wave action, ocean bottom characteristics and aesthetics
- Structures are easily built with locally available conductive material (usually rebar)
- NO LIMITATIONS OF SIZE OR SHAPE



Rebar can be welded in any shape

Considerations for building a Biorock Reef

- Depth of water
- Type of ocean bottom
- Distance from shore
- Availability of electric power
- Availability of broken coral fragments
- Dedication to maintaining reef operation
- Funding


1 year old Biorock reef, Karang Lestari,
Pemuteran,Bali, Indonesia
J. Cervino 2004


3 year old Biorock reef, Karang Lestari, Pemuteran, Bali, Indonesia
J. Cervino 2004

Typical costs

- Design —
- Rebar —
- Cables —
- Solar collectors —
- Voltage generators —
- Labor —
- Travel —
- Licensing fees —
- Consulting fees —

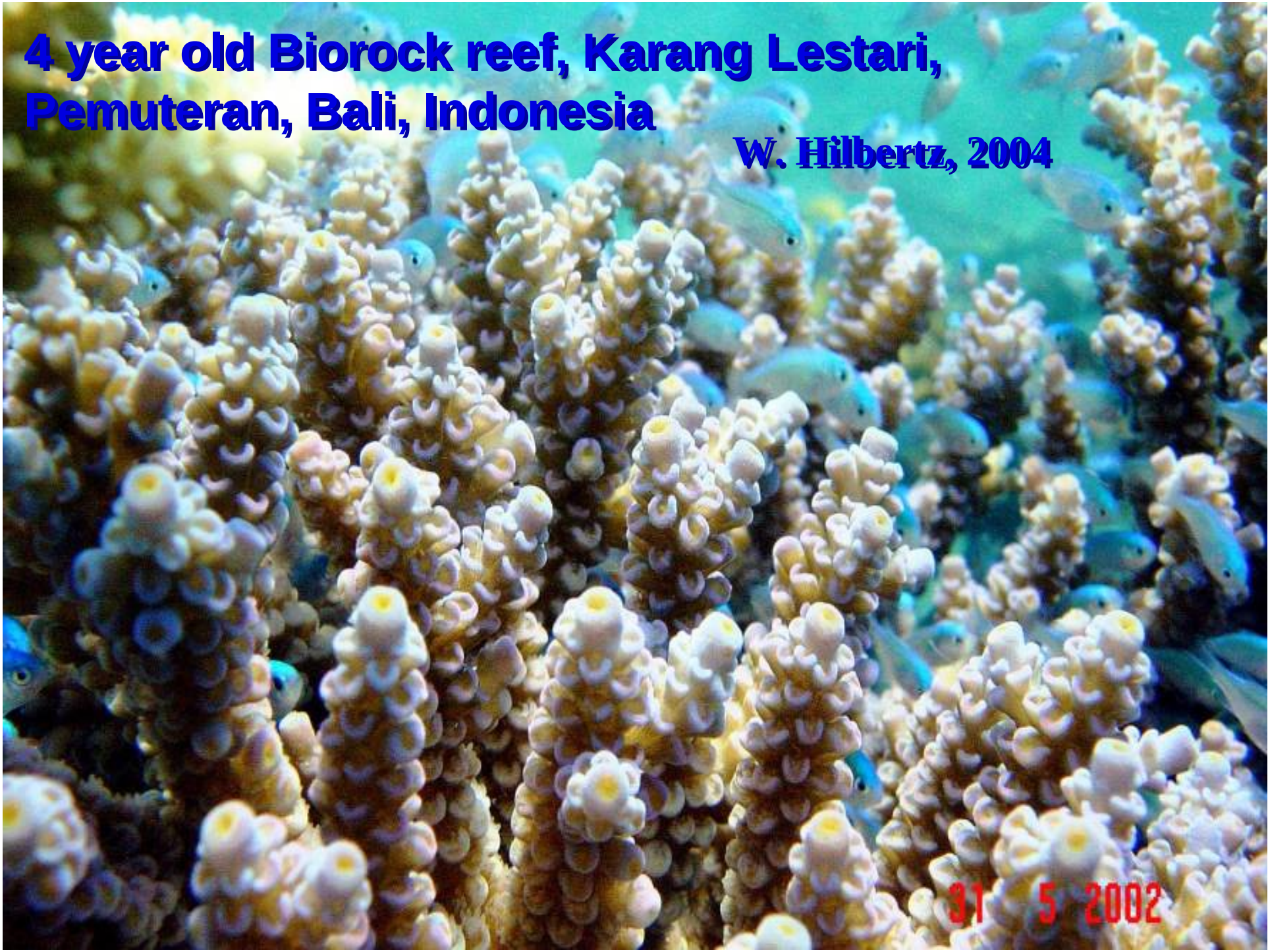

3 year old biorock reef, Karang Lestari, Pemuteran, Bali, Indonesia
J. Cervino 2004

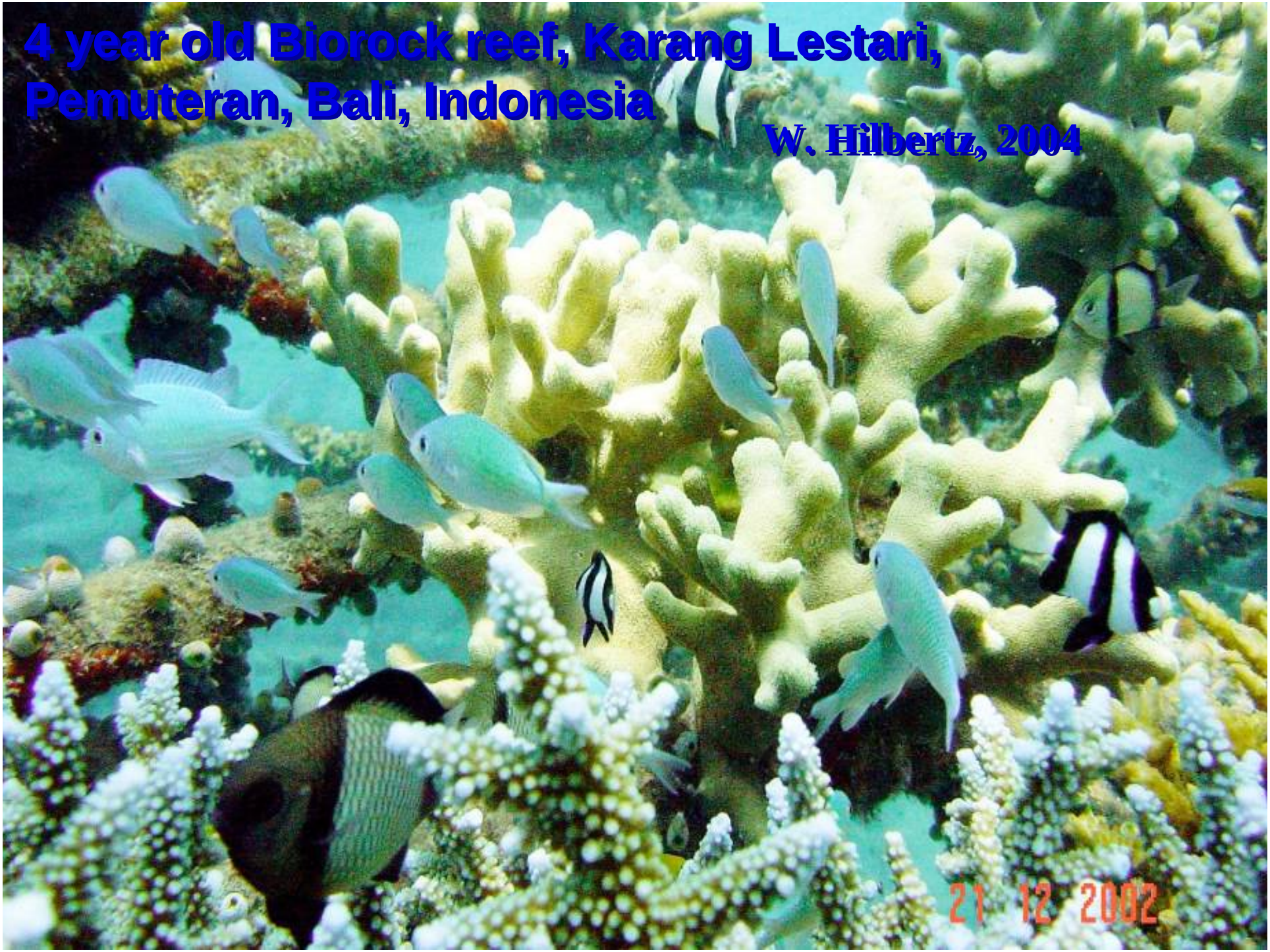

3 year old Biorock reef, Karang Lestari,
Pemuteran, Bali, Indonesia
J. Cervino 2004


3 year old Biorock reef, Karang Lestari,
Pemuteran, Bali, Indonesia
J. Cervino 2004

BIOROCK CORALS

- Grow 3-5 times faster
- Heal more than 20 times faster
- Survive high temperatures 16-50 times more than adjacent reefs
- Have hundreds of times higher baby coral settlement
- Attract incredible numbers of fish


4 year old Biorock reef, Karang Lestari,
Pemuteran, Bali, Indonesia
W. Hilbertz, 2004
31 5 2002


4 year old Biorock reef, Karang Lestari,
Pemuteran, Bali, Indonesia
W. Hilbertz, 2004
21 12 2002

- Corals can survive under lethal conditions
- Reefs can be quickly restored where they can’t recover naturally
- Fishermen can grow reefs and greatly increase fish and shellfish populations and catches, becoming farmers instead of hunters
- Breakwaters can be built for a fraction of the price of concrete or stone, with vastly greater environmental benefits
- Winner of many international environmental and ecotourism prizes

BIOROCK REEFS CAN BE BUILT IN FORMS THAT GREATLY INCREASE HABITAT FOR AND POPULATIONS OF FISH, LOBSTERS, AND OYSTERS

GROW ENTIRE COMPLEX ECOYSTEMS WITHOUT ADDITION OF FOOD, AND SO AVOID THE GENETIC IMPOVERISHMENT, DISEASE, PARASITE, AND POLLUTION PROBLEMS CAUSED BY CONVENTIONAL MARICULTURE

FISHING COMMUNITIES ARE HUNTERS, DESTROYING WILD ANIMALS AND THEIR HABITAT IN ORDER TO SURVIVE

USING BIOROCK THEY CAN BECOME SEA FARMERS, WHO RESTORE AND IMPROVE THEIR HABITAT IN ORDER TO PRODUCE MORE

THE NEOLITHIC REVOLUTION REACHES THE SEA 10,000 YEARS AFTER LAND

Biorock is the cheapest and most cost effective solution for:

- Coral reef restoration
- Fisheries restoration
- Shellfish restoration
- Shore protection
- Mariculture
- Building stone and aggregate
- Protecting reefs from global warming
- Ecotourism

GCRA has built more than a hundred Biorock reefs in more than 20 island nations, and trained more than a hundred local people. We have had NO funding from any government or major funding agency, using only small in-kind local contributions. Local partners are people who find us when they realize their reefs are dying, and that they will lose them all if they don't start growing corals now.

Projects can be any size or shape, and range up to 50 structures totaling half a kilometer of reef in the Pemuteran Village Protected Area, Bali, using power equal to ten 200 watt bulbs.

Global Coral Reef Alliance

A tax exempt non-profit organization for coral reef protection, sustainable management, and restoration, based on a worldwide network of volunteers divers, scientists, fishing villages, officials, and others who care about the future of our coral reefs

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