







Time series analyses of fish abundance from an artificial reef and a reference area in the middle Adriatic sea




G. Scarcella, F. Grati, F. Domenichetti, L. Bolognini, P. Polidori, S. Manoukian, G. Fabi
CNR - Institute of Marine Sciences (I SMAR), Ancona, Italy

10TH SEPTEMBER 23-27, 2013

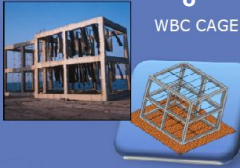






THE 10TH INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS


Location and history of Senigallia AR



0.5 Ha



8 WBC CAGE



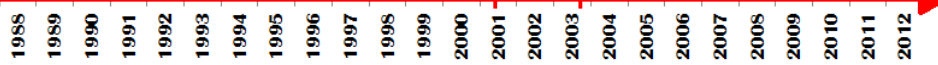
29 WBC PYRAMID

Start of mariculture experiments inside the AR

Deployment of coal ash blocks for *Pholas dactylus*






Deployment of Tecnoreef® module

Open reef project (3 years of increasing fishing effort)



1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

10TH SEPTEMBER 23-27, 2013

THE 10TH INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS

Previous studies

Comparison Between an Artificial Reef and the Adriatic Sea: Analysis of Four Years

Gianna Fabi
ICIES Journal of Marine Science, 59: 411-420, 2002
doi:10.1006/jmsc.2001.1173, available online at <http://www.sciencedirect.com>

An assessment of biomass and structure of an artificial reef (Adriatic sea) using a diver-operated camera

G. Fabi, and A. Sala

BULLETIN OF MARINE SCIENCE, 7(7), 95-96, 2006

FEEDING BEHAVIOR OF THREE COMMON FISHES AT AN ARTIFICIAL REEF IN THE NORTHERN ADRIATIC SEA

BRAZILIAN JOURNAL OF OCEANOGRAPHY, 59(special issue CARAH):145-153, 2011

MULTIBEAM INVESTIGATION OF AN ARTIFICIAL REEF SETTLEMENT IN THE ADRIATIC SEA (ITALY) 33 YEARS AFTER ITS DEPLOYMENT*

Sarime Manoukian^{1,2}**, Gianna Fabi¹ and David F. Naar²

¹CNR - Istituto di Scienze Marine, Sede di Ancona (Largo Fiera della Pesca, 60125 Ancona, Italy)

²College of Marine Science, University of South Florida (140 7th Ave South, St. Petersburg, 33701 FL, USA)

**Corresponding author: sarime.manoukian@an.ismar.cnr.it

ABSTRACT

...elements of the single units have been observed. Moreover a deepening of the structure was observed.

5th CARAH
Long Beach
California
(USA)

6th CARAH
Tokyo
(Japan) -
EMBS
Southampton
(UK)

7th CARAH
San Remo
(Italy)

8th CARAH
Biloxi
(USA)

9th CARAH
Curitiba
(Brazil)

1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

SEPTEMBER 23-27, 2013

CARAH

THE 10th INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS

Qualitative monitoring of AR spoilage

1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

SEPTEMBER 23-27, 2013

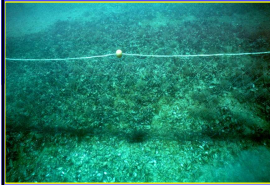
CARAH

THE 10th INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS

Fish collection

MONTHLY SURVEYS SINCE 1988

SAMPLING METHOD: BOTTOM TRAMMEL NET



500 m long, 2 m high
inner mesh size 70 mm
outer mesh size 400 mm



SAMPLING AREAS:



ARTIFICIAL REEF

REFERENCE AREA

SET TIME: 12 h



Data analyses

- Species abundance by monthly sampling

$$N_{\text{Artificial Reef}} = N_{AR} \text{ (N.ind./ 500m/ 12h)}$$

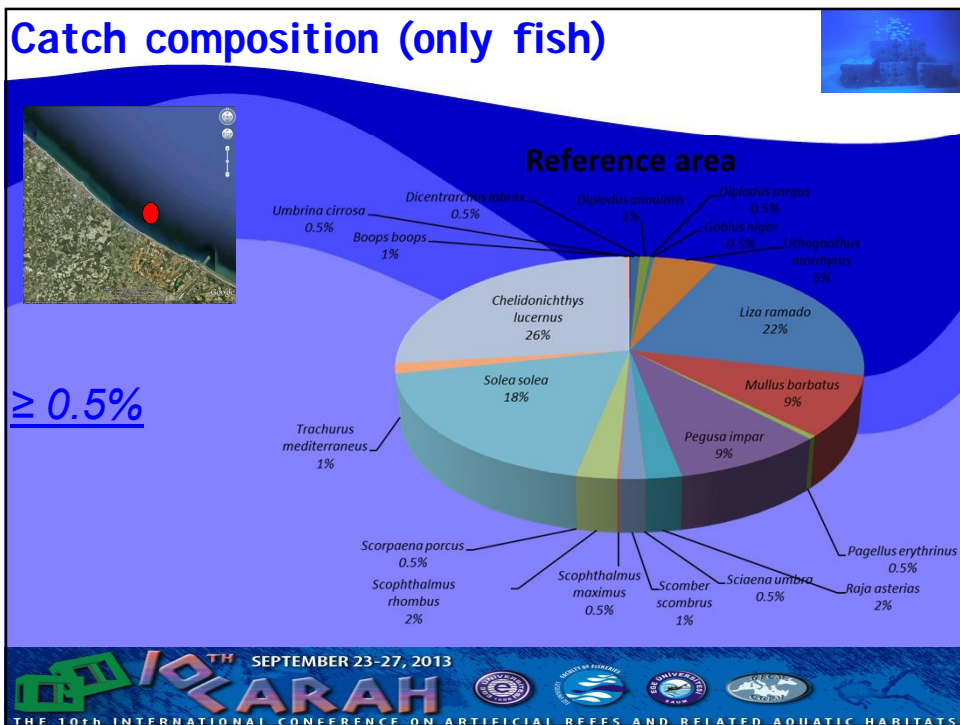
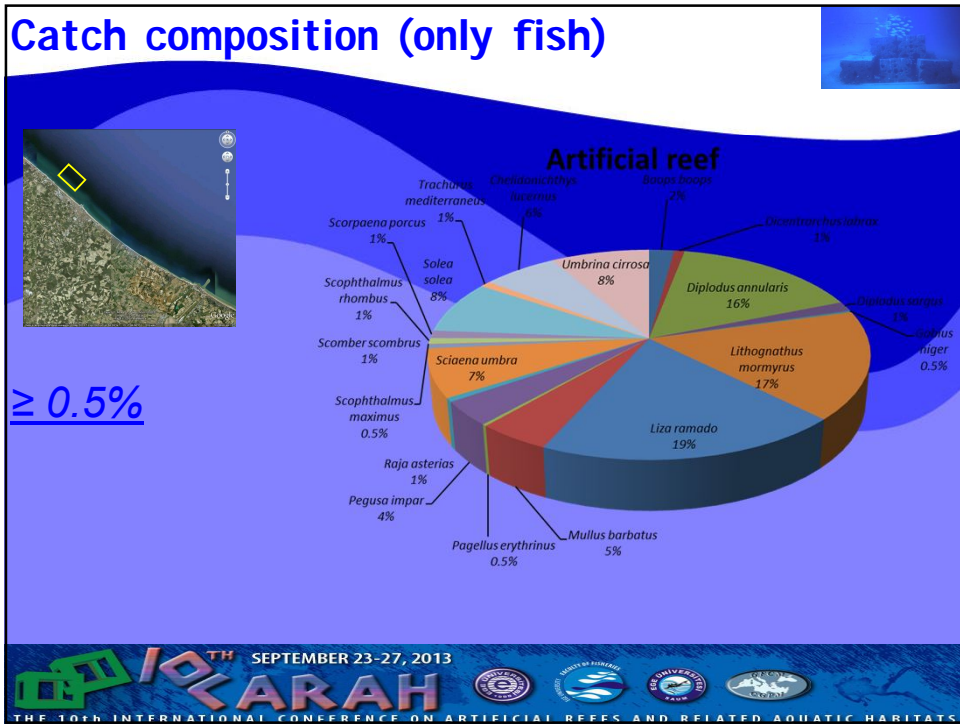
$$N_{\text{Reference Area}} = N_{RA} \text{ (N.ind./ 500m/ 12h)}$$

- Mean values by year for each area

- Ratio by year

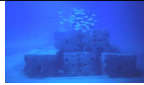
$$R = \log \left(\frac{N_{AR} + 0.1}{N_{RA} + 0.1} \right)$$






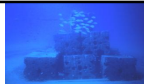
Time series analyses

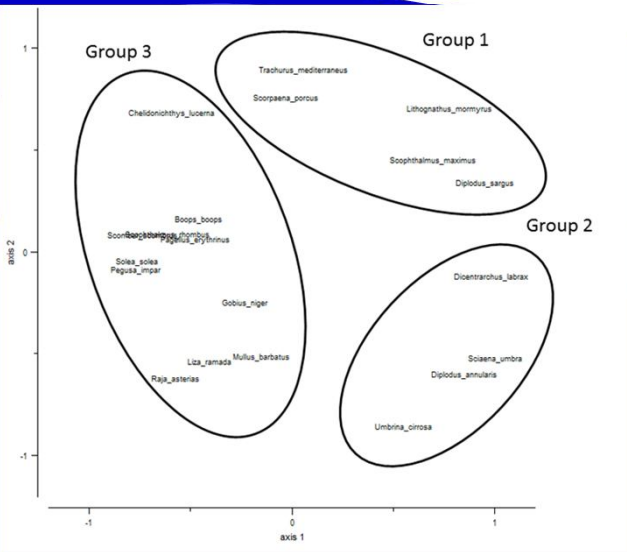
- Are there common trends?
- Do the time series interact?
- Are there sudden changes?






Are there common trends?





MultiDimensional Scaling (MDS) can be used to graphically represent a matrix of dissimilarities in a time series. Points close to each other correspond to time series that are similar (high correlation).



Do the time series interact?

MAFA (min/max autocorrelation factor analysis) is a type of principal component analysis especially for (short) time series, for extracting trends from multiple time series.

DFA (dynamic factor analysis) is a method to estimate common trends, interactions between response variables in a multivariate time series data set.

10TH SEPTEMBER 23-27, 2013

IOCARAH

THE 10TH INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS

Are there sudden changes?

$\alpha = 0.01$

$\alpha = 0.05$

$\alpha = 0.1$

$\alpha = 0.2$

$\alpha = 0.3$

Ordinary clustering techniques might be applied to identify sudden changes, but these methods are likely to result in groups of years that are difficult to interpret. Chronological clustering requires two parameters to be set:

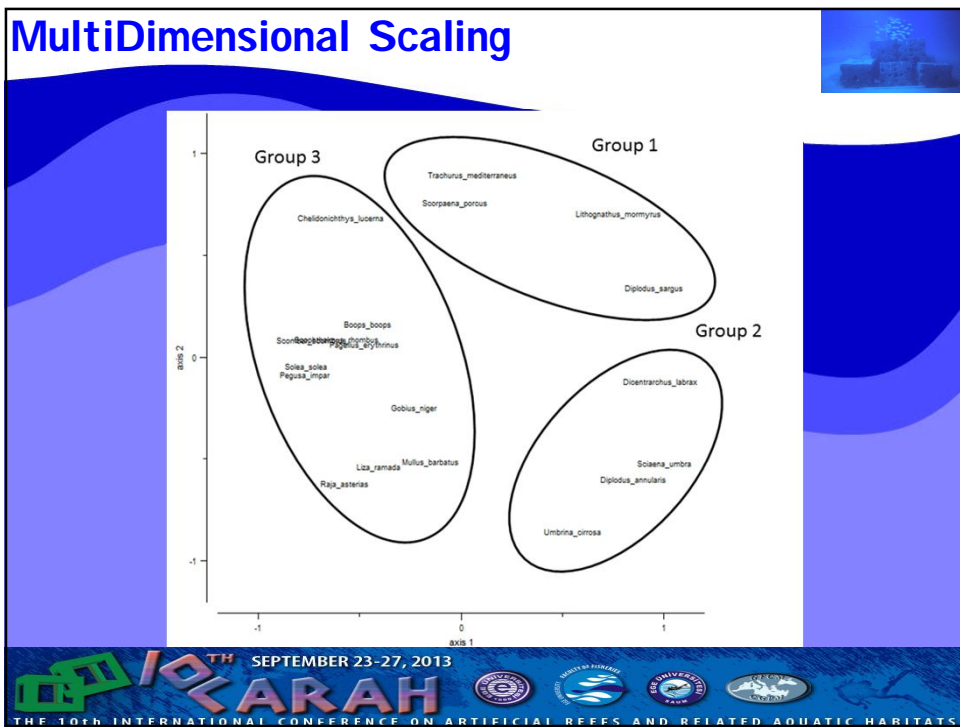
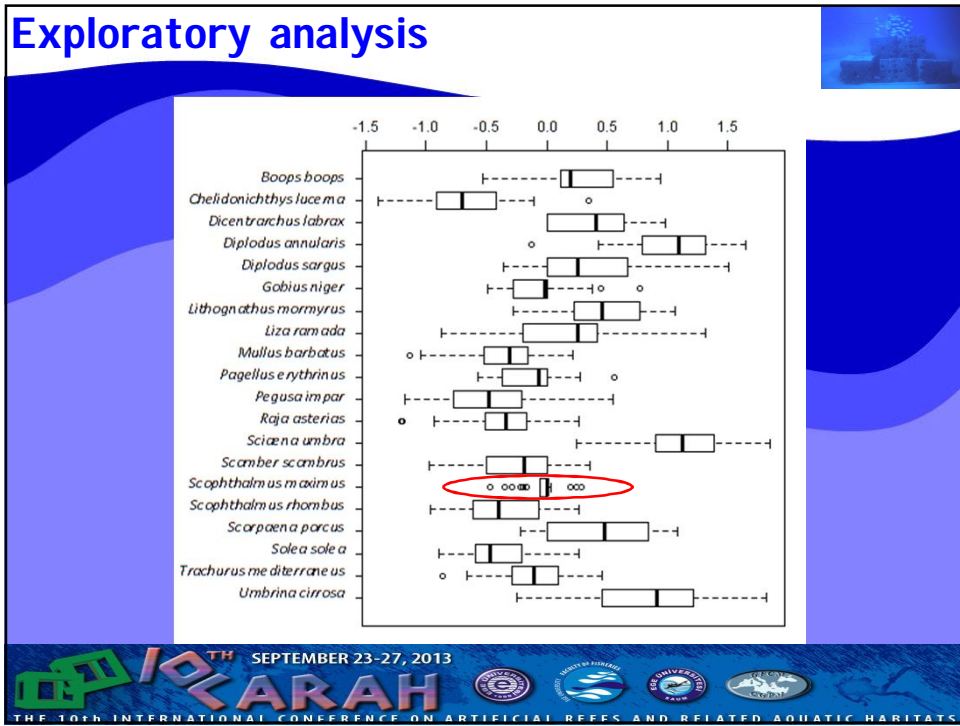
- coherence
- fusion level (α)

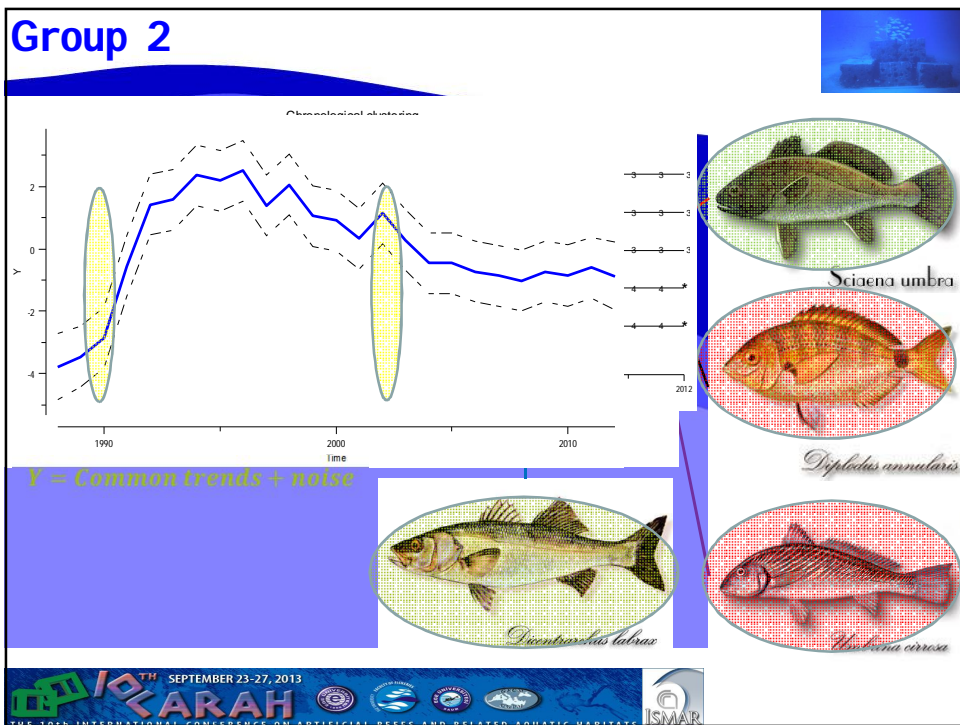
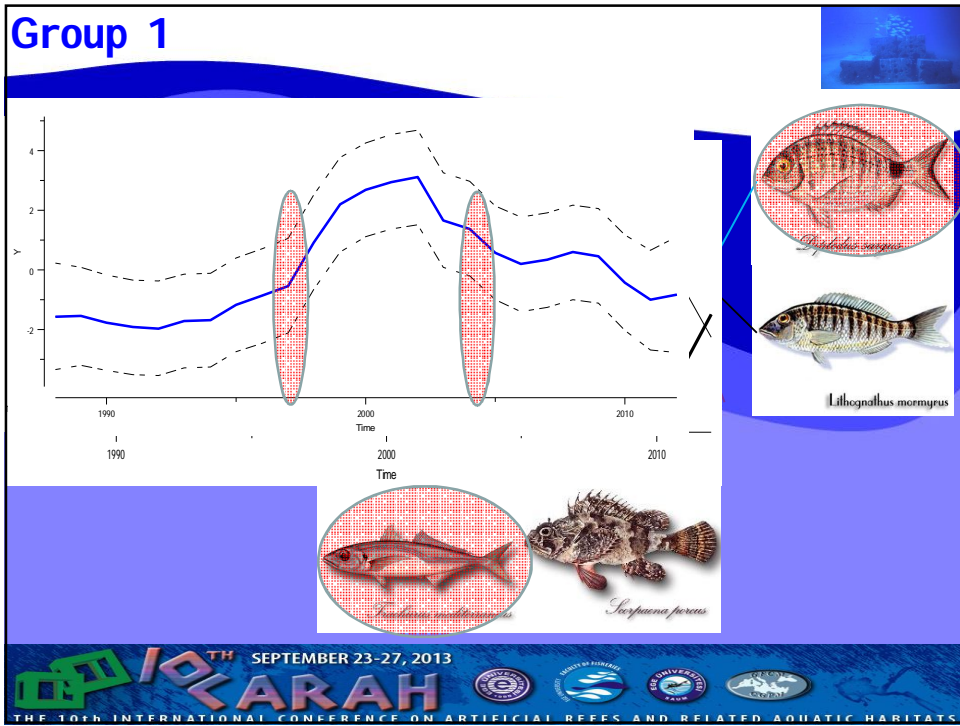
Small values (0.05, 0.01, 0.1) provide a birds-eye overview. Higher values of alpha (0.2, 0.3, 0.4) give more detailed information and therefore show more breaks in the time series.

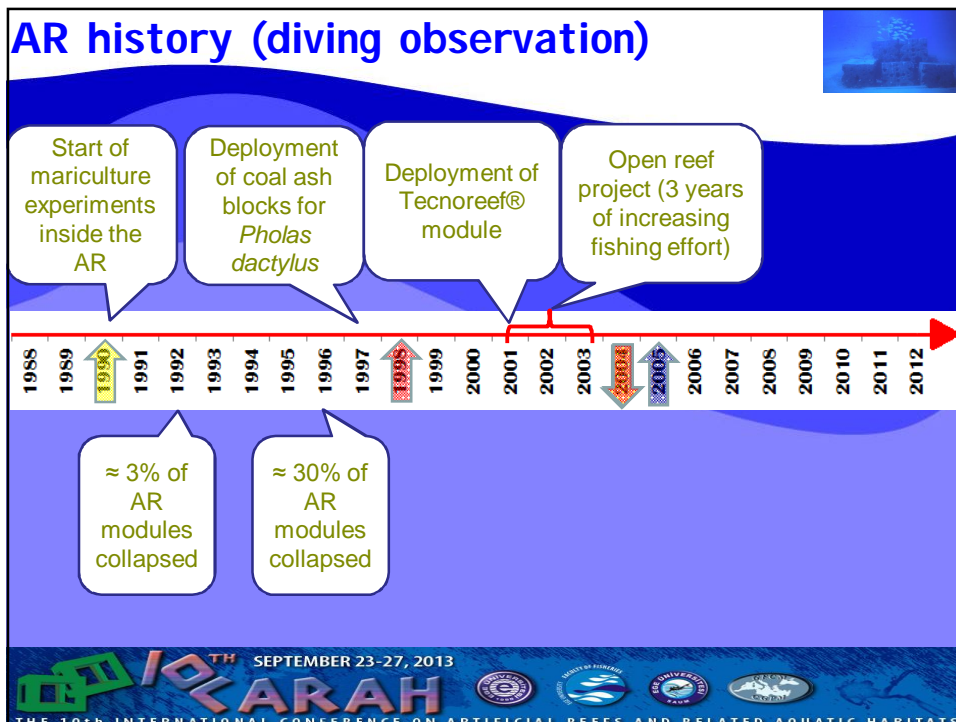
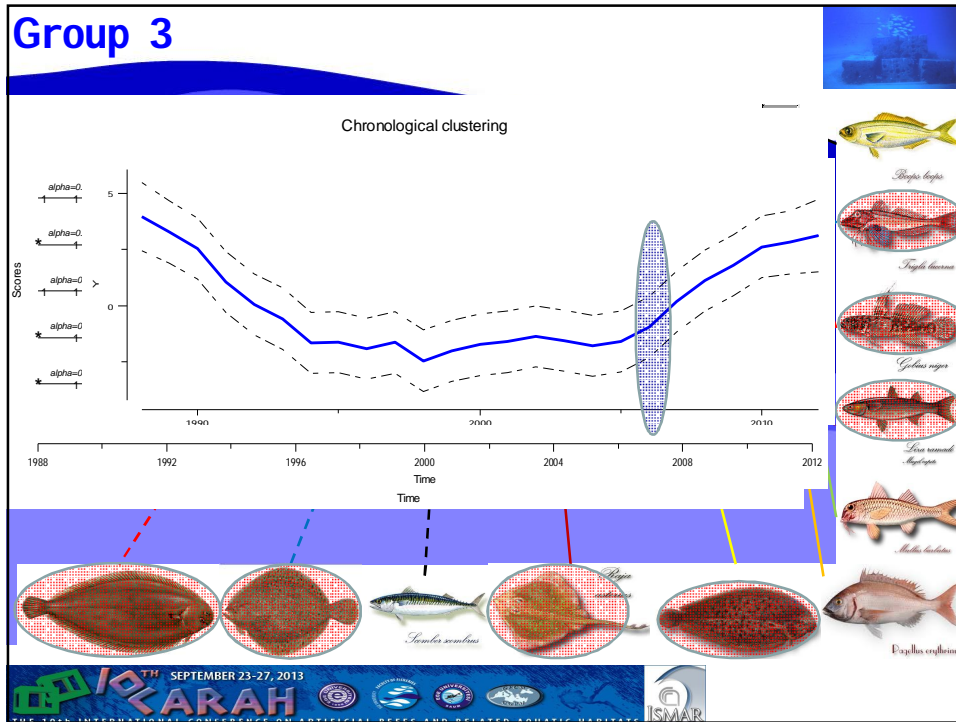
10TH SEPTEMBER 23-27, 2013

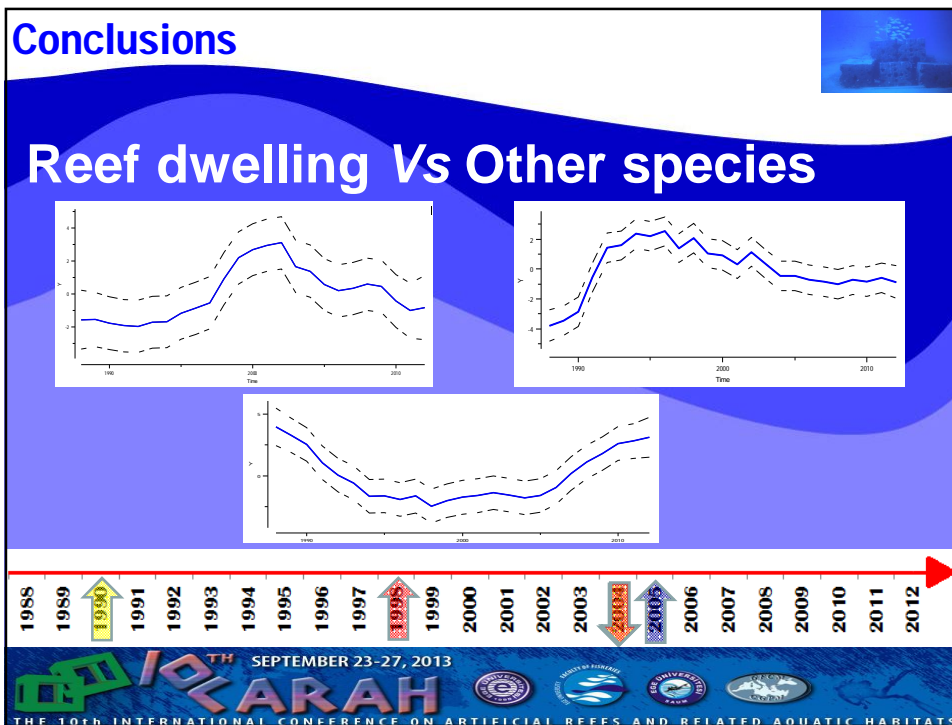
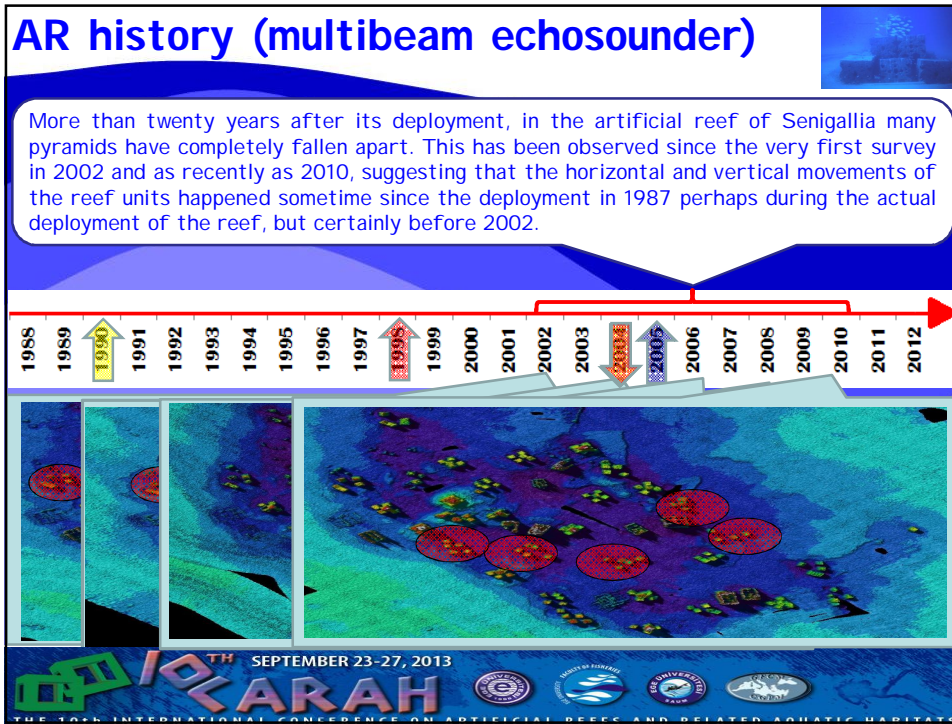
IOCARAH

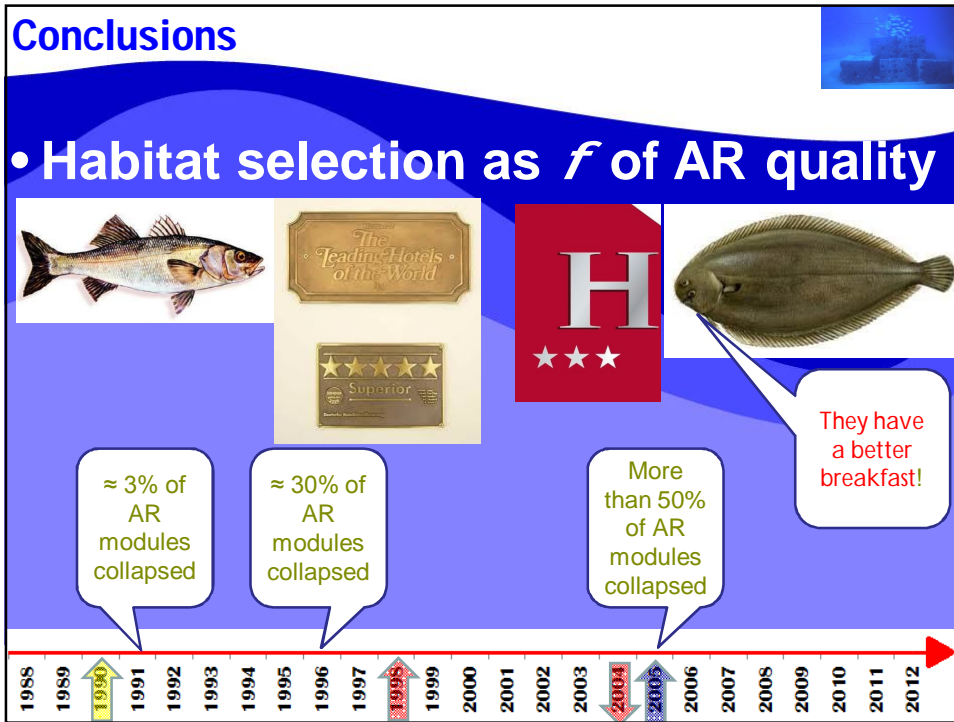
THE 10TH INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS











THANKS FOR THE ATTENTION

g.scarcella@ismar.cnr.it

ROMA - 27.08.1976 - ORE 13.20 - INIZIO DI UNA LEGGENDA.
TANTI AUGURI CAPITANO

10TH SEPTEMBER 23-27, 2013

IOCARAH

THE 10th INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS AND RELATED AQUATIC HABITATS