

## **Croatia/USA Workshop Report**

**Biocomplexity and sustainable ecosystem management:  
Integrating natural, social and economic sciences.**

*Dubrovnik, Croatia, October 6 - 12, 2002*

**Center for Coastal Resources Management  
Virginia Institute of Marine Science  
College of William & Mary**

## Contents

Introduction.....	3
Workshop Background.....	4
Workshop Objective.....	5
Workshop Findings & Recommendations.....	6
Biocomplexity Project Components.....	7
Attachment 1: Workshop Agenda.....	9
Attachment 2: Workshop Minutes.....	10
Attachment 3: Participant List.....	16
Attachment 4: Description of Croatian Coast & Islands.....	18
Attachment 5: Croatian Scientists Study Visit.....	22

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Sponsors: US National Science Foundation, Croatian Ministry of Science and Technology, College of William & Mary/Reeves Center.

Organizing Committee: Adam Benovic, Anamarija Frankic, Tarzan Legovic, Stjepan Marcelja, Vladimir Lay and Vera Žutic.

## **Introduction**

Virginia Institute of Marine Science/Center for Coastal Resources Management (VIMS/CCRM) is planning to propose a research and management project that will combine field studies, biological and hydrological models, and socio-economic studies to explore bio-complexity and to implement sustainable ecosystem management in coastal systems. This project will use an interdisciplinary approach to inform and guide management. The underlying assumption to the anticipated work is that the environment sets limits on sustainable development. This implies that a comprehensive knowledge of the physical, chemical, and biological components of any system must be understood as a prerequisite to optimizing management of social and economic forces. Planning for sustainable uses of coastal systems therefore requires comprehensive analysis of natural resources conditions and socio-economic conditions

Successful management of the benefits derived from complex systems requires recognition of the importance of both time and space in the process. This challenge is particularly acute in coastal systems because of the large and complex fluxes of materials that characterize these systems. Understanding spatial and temporal patterns and their role in determining long-term system performance is basic to appropriate guidance for management. For this reason, we intend to pursue a comprehensive analysis of the target study areas by engaging researchers across a variety of disciplines, including physical, biological, and social sciences. Spatial and temporal patterns will be emphasized in all analyses undertaken.

In general, the project would explore the options available to optimize benefits derived from coastal system bio-complexity. This would include practical understanding of: a) what sustainable development and sustainable use mean for coastal ecosystem functioning; b) how management goals can be appropriately established on both temporal and spatial scales for biocomplexity in dynamic coastal systems; and c) how progress to these goals can be measured, monitored and replicated. Sustainable development in this project will involve science and management in time and space of the constant interactions between ecological and economic, and social and natural variability, supporting co-existence of ecosystems and lifestyles side by side.

## **Workshop background:**

**In order to initiate development of the project proposal, VIMS/CCRM is proposing to organize a workshop on “Biocomplexity and Sustainable Ecosystem Management: Integrating natural, social and economic sciences”, to be held in Dubrovnik, Croatia, October 6-12, 2002.**

The goal of the workshop is to bring together scientists from different fields and institutions, from the US and Croatia, in order to improve collaboration and research integration for sustainable coastal and marine ecosystem management. Preliminary ideas for the potential project proposal will be presented, discussed, and elaborated. This workshop will bring together already existing research partnerships between two countries and establish new ones. This workshop will help develop a more comprehensive approach to research in support of integrated management of complex coastal systems. Workshop participants will be selected from scientific, educational, and management institutions and organizations, holding particular expertise in marine research, biodiversity conservation and management, social and

economic research related to ecosystem conservation and management, and coastal and island sustainable development.

The workshop objective is to develop a generic model of system's components interactions and implement it through the proposed biocomplexity project. The interaction between biological, physical, social and economic components will be addressed during the workshop discussions. The workshop participants will identify the key linkages between components and identify related questions and research that needs to be addressed. The workshop groups will also identify potential control points that are necessary for management of the biocomplexity system. Based on these findings, the workshop will outcome with a draft generic model that will show how each component relates to each other, what are the links and control points between system's natural and human resources, and what proposed project would best implement developed model.

More information on biocomplexity projects and NSF project examples at:  
<http://www.nsf.gov/pubs/2002/nsf02167/nsf02167.htm>.

### **Workshop objectives:**

The workshop objectives are: a) to identify and prioritize cross-cutting research needed to support understanding of biocomplexity and ecosystem management; b) to facilitate the exchange and integration of information about coastal and marine ecosystems natural, social and economic sciences; c) to establish liaisons and collaboration between related activities/projects, researchers, and managers; and d) to develop South Adriatic Biocomplexity project proposal that will systematically explore the following suggested core questions:

#### **1. How to maintain large scale ecosystem functioning with sustainable human interactions?**

It is important to understand interactions and relationships between healthy ecosystem function and site-suitability modelling of resource uses. Both practical research and modelling should investigate the maintenance of biodiversity across the landscape and large-scale coastal and marine ecosystems. The basic questions to be answered are how do ecosystems function as a whole unit and how do human impacts disrupt ecosystem function?

#### **2. How biodiversity changes effect ecosystem functioning, specifically changes caused by certain human uses: e.g. coastal agriculture, fisheries, aquaculture and tourism activities. And how to distinguish and measure/monitor acceptable changes and unacceptable changes for natural processes?**

To address these questions a potential project should research and identify indicator species for the assessment of habitat and ecosystem function and health. At the same time, the project should research and identify three primary determinants of use patterns in coastal areas: environmental factors; social factors; and economic factors.

#### **3. How to manage and reverse environmental damage caused by anthropogenic unsustainable uses, including practical and policy responses?**

Impacts of marine pollution, climate change, eutrophication, fragmentation, over-fishing, land use and development operate across coastal ecosystems. Research, conservation and management has traditionally concentrated on discrete sites, and now has to involve best

practices and cost-effective solutions that will support bio-complexity objectives at a range of scales.

**4. What are the implications for biodiversity of current management systems and alternative options at different spatial scales?**

This multidisciplinary research should be based on fundamental understanding of coastal ecosystem functioning. The goal is to apply this knowledge to management scenarios, including current systems and feasible options, to measure and predict impacts on biodiversity components, ecosystem structures, function and health. Research should focus on key structural features and selected keystone species or functional groups that cross individual habitat categories. In addition, advanced research needs to integrate interactions of drivers at multiple scales such as eutrophication and climate change.

**5. What are the socio-economic implications of management options?**

Collaborative research should build on models for site suitability analysis, incorporating recognition of values associated with various uses/services, including biodiversity. Socio-economic components should be added to the environmental site suitability analysis, predicting the most suitable options and practical constraints. The suggested project would develop decision support tools that guide the best choice of management objectives and methods.

**6. What are the effects of management in practice?**

This would be answered by testing the best, predicted options over suitable spatial and temporal scales. Multidisciplinary, integrated research should result in the identification of best practical techniques for coastal bio-complexity management, including coastal habitats protection and restoration, ecosystem functioning and health, socio-cultural heritage protection and restoration, as well as economic sustainability. Selected pilot projects would develop and test methods of risk assessment and management of uncertainty in decision-making process. Spatial tools (integrated GIS) and decision support systems would be developed to enable analysis of ecological and socio-economic aspects of bio-complexity at small and large spatial scales. The suggested project should also develop methods to share the best practices in awareness raising, education, communication and conflict resolution.

**Workshop design:**

The workshop will be structured into two sessions and two field trips. The first session will focus on identifying and prioritizing cross-cutting multidisciplinary research necessary to support biocomplexity understanding and sustainable ecosystem management. This process will be initiated prior to the workshop through the email discussion group, and inputs and discussion will continue during the workshop. A second session will identify potential priority project(s) based on the suggested core questions, and develop a first draft project proposal(s) with suggested pilot project areas. We suggest a one-day boat field trip to the Mljet island, and in the end of the workshop one-day field trip to the Mali Stone Bay (see Workshop Agenda, Attachment 1).



### **Workshop outputs and next steps**

The workshop outputs include: 1) report documenting workshop findings and recommendations for the next steps of this collaborative process between the US and Adriatic region; 2) first draft-idea of the identified research project proposal for the South Adriatic Region that will develop and implement innovative approaches in biocomplexity and sustainable ecosystem management.

#### **1) Workshop findings and recommendations**

First of all, we have to mention that this workshop represents a pioneer initiative in Croatia. This was the first workshop that brought together representatives from disciplines of natural, social and economic sciences to develop a collaborative project in the South Adriatic Region. Workshop discussions identified that the main problem is a lack of comprehensive scientific data related to coastal and marine ecosystems understanding. The existing data are not available in integrated way and have not been assessed so that they could be useful to stakeholders, policy and decision makers but have been exploited to write scientific articles and reports of various projects. Another identified problem is lack of communication and collaboration among scientific institutions. This will change when more collaborative and interdisciplinary projects are initiated. There is an urgent need for initiatives similar to this one, and projects that will establish higher level of efficiency in scientific application and connection to management issues in the Adriatic region.

Workshop had three key outcome recommendations (see Workshop minutes, Attachment 2):

- a) To develop multidisciplinary South Adriatic project from several suggested research projects.
- b) To initiate steps for exchange of students and young experts between USA and Croatia; and
- c) To establish graduate and undergraduate studies in environmental and coastal management in Dubrovnik, Croatia (already underway, with first semester starting in fall of 2003).

## 2) Research project components - Draft ideas:

- a) Croatian South Adriatic System (CSAS) with two case studies (Mljet Island and Mali Ston Bay) and suggested theme: 'changes in the environment due to global and local impacts'. Both global and local impacts are affecting people's lives; therefore scientific knowledge about natural resources should be considered when constructing guidelines for future development. Suggested project will specifically address research in physical oceanography (e.g. water mass movements especially in the case areas); plankton dynamics (focusing on medusas as indicators of water movements, and possible ecosystem changes); benthic dynamics – tracing several indicator species of fish (fingerlings) and shellfish; socio-anthropologic and economic research – addressing social changes that came about as a result of natural changes (e.g. investigate efficiency of protection in the Mljet island - comparison between area that is a national park and unprotected part of the island, and efficiency in usage of the sea in the Mali Ston Bay).
- b) Socio-economic component of the project on the Mljet island as well as the Dubrovnik county would address changes in fish species and fishing gear, and develop a mathematical model of effects these changes bring about; many exotic species occur after periods of Adriatic ingressions; number of species (biodiversity) is increasing, while abundance of certain pelagic fish species is decreasing (comparisons based on monitoring data, even from 19-th century).
- c) There is a limited understanding of biodiversity and of benthic-pelagic coupling in South Adriatic. Therefore it would be essential to identify important habitats (and follow with habitat suitability modeling). In terms of benthic research it would be beneficial to analyze bivalves *Pinna nobilis*, *Lithophaga lithophaga* (potential key indicator species for coastal ecosystems), and *Arca noe* (e.g. increase on the market of *Arca noe* is related to the increase of fisheries); expanding sea grass meadows (*Caulerpa taxipholia* and most recently introduced *Caulerpa racemosa*) their distribution and effects on the biodiversity. How changes in filter feeding community affect biocomplexity in coastal zone (comparison between Mljet as the baseline, and Mali Stone that is affected by human activities and mariculture); and what are the consequences on larval dispersion? Island Mljet is a practical example of natural and social coupling, and it could be a 'microcosm study area' where all the aspects of biocomplexity, management and protection could be performed; distribution of habitat types and requirement for key species would be done, and overlaid (GIS modeling) with stresses and anthropogenic impacts (identify risks – air-born, terrestrial, water-born pollution, existing and potential). Analysis of management strategies is apparently needed with an identification of the most profitable sustainable activities. There is a necessity to compare and model fishing activities outside and inside protected area of the island Mljet (including two lakes).
- d) Effects of ingressions on biocomplexity in the coastal sea; quantification of biocomplexity dynamics in coastal areas (physical, biological, chemical, social and economic changes). Sea current along eastern Adriatic brings intermittently, through ingressions, a number of planktonic species from the Mediterranean through the Ionian Sea. These species increase biocomplexity of the Adriatic Ecosystem. What is the role of this impact? What is the rate of settlement of various species in the south Adriatic region? What is the implication of this impact to conservation attempts and methods?

Through a high resolution 3-Dimensional model we can provide currents field that may be used to study ingression phenomena. We can add to it attachment mechanisms of various species and study what attachment is expected. Using data in the field on several spots it would be possible calibrate the model. The model could then be used to predict attachment rate in the whole area and especially to areas of concern such as Mljet and Mali Ston. Concerning Mali Ston, nesting of models would be needed to capture small-scale features that exist in the bay.

**3) The next key step is to establish US-Croatia scientific team that will work on a development of the project proposal.**

Scientists from following institutes expressed their interest to participate in the project:

- Virginia Institute of Marine Science, School of Marine Science, Center for Coastal Resources Management, focusing on: integrated coastal and ecosystem management, use suitability modeling, and biocomplexity research;
- Institute of Oceanography and Fisheries, labs in Split and Dubrovnik concerning fishery, plankton dynamics and benthic biodiversity;
- Institute 'R. Boskovic', Center for Marine and Environmental Research, Zagreb concerning on hydrodynamics, theoretical aspects of phytoplankton dynamics, mathematical models of ecosystem dynamics and atmospheric transport processes;
- Institute of Social Sciences 'Ivo Pilar', Zagreb focusing on human aspects;
- Department of Biology, University of Zagreb, concerning phytoplankton dynamics;

In addition to the above it was agreed that the report of the meeting be circulated to other potential partners including Economic Institute in Zagreb and the Department of Sociology, University of Zagreb. Officials working at departments of physical planning and public health of the Dubrovnik County also expressed their eagerness to participate in activities concerning their expertise.

It was suggested to bring several Croatian participants to the NCSE (National Council for Science and Environment) Conference in Washington DC, January 30-31, 2003; and to continue working on the proposal idea for the South Adriatic project (see Attachment 5).

It is important to acknowledge that the Croatian Ministry of Environmental Protection initiated a follow-up workshop on Wednesday, December 4, 2002, in Zagreb, which brought representatives of all relevant scientific coastal projects in Croatia. The participants from the Dubrovnik workshop were invited as well, and Dr. Adama Benovic and Dr. Tarzan Legovic presented the biocomplexity project initiative for the South Adriatic Region.

## **Attachment 1**

### **Workshop Agenda**

#### **Sunday, October 6**

Arrivals, registration and welcome

#### **Monday, October 7**

9.00 – 13.00 Topic: Overview of the South Adriatic System

Present working plan and guidelines for the workshop. Present general information about potential biocomplexity project in local systems. Overview of the South Adriatic system's natural, social and economic components:

- Natural characteristics (A. Benovic) – biodiversity, geology, oceanography, hydrography, fisheries;

10:30-11:00 Coffee break

- Social and economic characteristics (V. Lay): physical planning and health, demography, socio-economic structure, land use, current economic status, coastal pollution and degradation

13.00 – 14.30 Lunch

14.30 – 18.30

- Ongoing related projects and initiatives (A. Frankic)

- UNDP/GEF Adriatic Project presentation (V. Jelavic) – conserving biodiversity on the Dalmatian coast through integrated coastal management

- Project Adriatic (Ministry of Science and Technology) (Vilicic, Benovic, Legovic)

16:00-16:30 Coffee break

- Educational Initiative - Coastal resources management and policy in Croatia: urgent need to establish educational and capacity building mechanism – initiative to establish national and international educational center for applied marine sciences, technology and management – e.g. International Regional Center for Adriatic in Dubrovnik (S. Marcelja)

- NSF projects (T. Baerwald)

#### **Tuesday, October 8**

9.00- 13.00 Topic: Where we are heading? (V. Lay, T. Legovic)

- Introduction to VIMS and CCRM (C. Hershner)

- What is Biocomplexity? How do system's biological, physical, social and economic components interact?

Preparation for the conceptual modelling addressing interactions between components of the coastal/marine system;

13.00 – 14.30 Lunch

14.30 – 18.30

- What types of research can help identify linkages between system's components? And what are the potential control points necessary for managing the system?

- Identifying and prioritising potential research projects, preliminary drafting of research project concepts;

#### **Wednesday, October 9**

8.00- 19.00 Field trip – NP Mljet Island, research vessel “Naše more”

Mljet island and National park - natural characteristics (A. Benovic), socio-demographic structure, activities, issues (G. Mihelcic, NP Mljet)

#### **Thursday, October 10**

9.00- 13.00 – Development of a draft project model, synthesis of outlines and draft research, and implementation plan;

13.00 – 14.30 Lunch

14.30 – 19.00 - Workshop outcome: Draft ideas for biocomplexity projects in the South Adriatic system suitable for management implementation (T. Legovic, A. Benovic, A. Frankic)

#### **Friday, October 11 - field trip to Mali Stone Bay and departures**

## **Attachment 2**

### **Workshop Minutes**

#### **Sunday, October 6<sup>th</sup> 2002**

Arrivals, registration and welcome

#### **Monday, October 7<sup>th</sup> 2002, morning session**

**Stjepan Marcelja:** Opening of the Workshop. Introduction.

**Frankic:** Meeting scope and goals. Addressed the importance of interdisciplinary education for undergraduate and graduate students.

**Benovic:** Presentation on the south Adriatic Sea region: geography, geology, physical and biological oceanography, fisheries, and biodiversity. After a general overview, an emphasis was placed on the Mali Ston Bay and the island of Mljet where the richest data set exists and where a number of phenomena have been discovered which could be linked to biocomplexity themes.

**Lay:** Anthropogenic influence on the coastal and marine ecosystems. It is important to hear what local population envisions for their next step in development; Elaboration on the definition of biocomplexity; A need for coupling natural and social science, has been formulated for over 30 years starting with the Adriatic I, II and III projects supported in part by the UNDP; Elaboration of importance of interdisciplinary research, education and good contacts with local people. It seems that monitoring of the south Adriatic is scarce in terms of frequency and extent. The question regarding abundance of data in the coast waters versus open waters have been raised.

**Legovic** noted that all counties have data on microbiological quality of all public beaches for the last 8 years (sampled 10 times during summer seasons). Data on beach quality of several counties are posted on the web as soon as samples are processed, so that results are available from the beginning of summer for the current year.

As to the data on physical oceanography, nutrients, phytoplankton and fish their quantity and representativity decrease as we go up along the trophic chain.

**Martinovic-Vukovic** from the Department of environmental protection and physical planning of Dubrovnik-Neretva county, reported on the elements of physical planning. Starting from the Constitution of the Republic of Croatia a need to protect nature has been recognized. In 1994 the Law on the environmental and nature protection was passed by the Croatian Parliament. The law was followed by a number of decrees and regulations concerning the Adriatic Sea. A need to be very careful in exploiting its resources and protect from unsustainable use due to fragility of some components was emphasized. Recognition of importance of coastal area for Croatia and other countries on the Adriatic coast: has prompted acceleration of measures toward sustainable development. Marine and terrestrial territory of Croatia is of approximately the same size. There are 1185 islands in country's territory. Description of Neretva, Peljesac, islands, and coastal part of the county; Map of Mali Ston – with borders of special and strict reserve. Addressed collaboration with Bosnia and Hercegovina (B&H) in building and operating a large sewage system has been elaborated.

On Neretva estuary/delta and Hutovo Blato in B&H: In Croatia until now this area is not protected as a reserve, but 5 locations are protected as ornithological or ichthyological reserve. What do we want to do with our coastal areas? What will happen if we do not plan development? However, there is a decrease in population in many areas. In some places, Croatian territory in the Dubrovnik county is only 600 m wide. River Ombla – rijeka Dubrovačka is also protected since it represents a very important water supply for Dubrovnik city. Other rivers as well are draining into Adriatic sea from BH. Actions and consequences in this area in the last 40 years, when life styles changed. e.g. extensive agriculture in B&H and Neretva delta. Last 8 years monitoring of sea quality. Changes in economics, demography, use of natural resources. It is important to periodically reexamine decisions regarding possibilities of optimal development.

**Smoljan**, from the Department of Public Health of the Dubrovnik-Neretva County. Human population has significantly influenced nature and water, both very important resources for a tourism in the country. In 1989 within the Mediterranean program, monitoring of public beaches started in terms of sanitary quality. Criteria were given by law. In 1994, monitoring system of Land Based Sources (LBS Protocol) has been established. All

participating institutions have to obtain valid monitoring license and are subject to periodic intercalibration exercises. Important: towns and settlements are faced with problems of discharging untreated sewage water into the sea. Result is worsening of seawater quality in the vicinity of discharge points. In the county, 73% of people are connected to sewage system which discharges waste water into the sea (this figure includes tourists). Others use septic tanks. In the Dubrovnik city, 57% of the population is connected to the sewage system. The city has 47000 inhabitants. Map of existing sewage system and planned pressures was showed. Not all parts of Dubrovnik city are connected to the sewage system (e.g. the old town due to conservation reasons). Since 1970s sewage is transported to a wastewater treatment plant in Lapad and discharged into the sea after mechanical treatment. All hotels in Dubrovnik are connected to the sewage system. Statistical data are presented for the survey in 2001 at the point after the treatment and before release into the sea. The system is not as efficient as it should be. The problem is that this occurs in an area that is highly touristy. In Cavtat all hotels have discharges into the sea, some longer some shorter. Results were also presented for Zupa Dubrovačka, and Pelješac. Analyses of water quality measurements on beaches were presented. In Dubrovnik 26 beaches are monitored with about 10 samples per beach. During tourist season samples are taken biweekly (May 1<sup>st</sup> – September 30<sup>th</sup>). The county has 123,000 inhabitants.

**Lay:** Summary of actual and future hotspots in terms of pollution and other impact: urban waste waters, oil tankers, waste from cruise boats, fisherman pressures, nautical tourism, harbors and global warming.

**Benovic** noted that that capacity of environment for pollution and other impact assimilation need to be computed.

**Lay**, mentioned importance of spatial and temporal scales in the above.

**Klasinc**, pointed to atmospheric dispersion of air pollutants from thermoelectric power stations in Albania, Montenegro and Greece. **Dubrovnik County** has improved as a consequence of monitoring results being publicized and social pressure on polluters. Monitoring program included several intercalibration exercises in order to decrease a chance of spurious results.

**Martinovic-Vukovic** mentioned impact of the navy stationed in Montenegro. In addition in Popovo polje a lot of pesticides is used in agriculture. Raised question on possible impact to Mali Ston Bay. Importance of restoring traditional activities and keep people wanting to stay on the islands. There exists a problem of fire management in B&H, which has already resulted in adverse effects on terrestrial ecosystems.

### Monday, October 7<sup>th</sup> 2002, afternoon session

**Frankie** talked about existing projects and documents: Strategic Action Plan for protection of biodiversity of the Adriatic; project Adriatic; UNDP project for Dalmatia; Dalmatian Islands Ecoregional Action Programme (WWF project); and Coastal Pollution Prevention Project (WB loan);

**Vilicic** gave an overview of the Project ADRIATIC – National monitoring of the Adriatic Sea. Involvement of institutes, their research profiles and results so far.

**Jelavic** talked about developed through multi stakeholder participation and networking. GEF focal areas: climate change, biodiversity, international wastes, ozone depletion, land degradation, persistent organic pollutants. This is the GEF biodiversity operational program. The first GEF project that already started is the KEC (Karst Ecosystem Conservation) Project (total of US\$ 8.5 mil). Potentials for protection of biodiversity in Croatia are underestimated, and these are actually umbrella projects. GEF proposed outcomes: creation of enabling environment, institutional strengthening, investments (do not directly invest, but investment should follow GEF project). It is recognized that Croatia has globally significant biodiversity and ecosystems. Growing threats that might cause unrecoverable damages. Opportunity for replication in Mediterranean region and broader. Dalmatian Project (this is not GEF, UN or UNDP project), it is Croatian, self-driven project that addresses global biodiversity issues. Candidate sites: 1. Biokovo, 2. Mljet, 3. Kornati and Dugi Otok, 4. Vis and remote islands, 5. Konavle (terrestrial). GEF is not funding scientific research but only what is needed for implementing the project. 1. Building capacity, 2. Inter institutional coordination to promote ICEM and BD conservation, 3. Legislative and regulatory reform to promote ICEM and BD conservation. Project stages: Two development stages first 2002-03, second 03-04, full project 04-08. What, where and when – in terms of data collected previously.

**Hershner** asked what data do we need for hydrodynamic modeling versus what we already have. Have projections been made in relation to global warming?

Sea level and temperature data exist since 1950. Monitoring of Vir –Konavle, 4 times a year. No time series data – we have sparse data on points.

Discussion was held on an assessment of existing data on groups of organisms. Availability of social data has been examined with regard to census and demographic picture (standard data since 1953).

**Koprivanac** informed the meeting on attempts by the University of Zagreb to create a graduate study on Environmental management to be held in Dubrovnik. So far, the interest in the proposal was expressed by the Croatian Ministry of Environmental Protection and Physical Planning, Croatian Ministry of Science and Technology, Institute R. Boskovic, Ericsson Nikola Tesla, American Chamber of Commerce, Rochester Institute of Technology, University of Georgia and Massachusetts Institute of Technology. Since interest by students and employers of graduated students exist, the next steps in the planning include finalizing the financial base, details of the curriculum, the program and timing of the study. It is envisaged that within the next month the program will be presented to the University of Zagreb Senate.

**Baerwald** stated that NSF is eager to fund more projects. No money have been set aside. No precise upper limit. Projects have been funded from 10 K\$ to 2 M\$.

Proposals are competitive and of a high quality. Cost of US scientists can be covered. Collaborations are welcome. NSF welcomes good proposals.

Biocomplexity is a theme, which explores interactions among natural and human systems. Hence, interdisciplinarity, synthesis and integration are expected and encouraged. Accent would be on quantitative methods of biocomplexity. It would be good to elaborate how research leads to education and exchange of Croatian and US students.

Biocomplexity is not the only niche; studies on process models and processes within natural science themes are also welcome in appropriate departments of NSF.

Competitiveness: 7 out of 56 projects get funded i.e. 12 % success. Up to 3 out of 15 smaller projects (of about 100 K\$). Most common requests 1.2 M\$ but now there is more interest to fund smaller projects.

Criteria: a) intellectual merit; b) broader impact to education and service to society.

**Klasinc** talked about experience of his group specializing in atmospheric chemistry on EU projects with regard to climate change. Collaboration with EUROTRAC is the largest atmospheric project since 1970 mostly on tropospheric ozone.

#### **Tuesday, October 8<sup>th</sup> 2002, morning session**

**Hershner** talked about projects on VIMS that can be related to this project. VIMS was created 60 years ago as fisheries center for technical advising. Now 400 people work there. Research ranges from coastal oceans to Antarctica. CCRM (Center for coastal resources management) focuses on: wetlands management, coastal zone management, use suitability modeling, specifically aquaculture. Examples: shallow water use management, clam aquaculture, big issues on bottom aquaculture, conflicts with submerged aquatic vegetation (SAV). What is important for preservation of biodiversity? You can either have aquaculture or preservation of habitat and biodiversity. Eutrophic waters are heavily impacted by land use. Much effort is focused at trying to change human behavior in near-coastal area. All data are in GIS. Parameters that determine suitability of site for clam aquaculture: bathymetry, exposure, and bottom type. Chesapeake bay, world largest estuary is eutrophic. Much work has been invested in organization of the area, estimation of impacts, aquaculture, fisheries – crustaceans, shellfish and finfish.

**Bilkovic** presented examples of ecosystem approaches to fisheries management. Using ECOPATH/ECOSIM – software package, [www.ecopath.org](http://www.ecopath.org) EAGLES – Estuarine and Great Lakes Indicator Research Program addresses fish and habitat interaction. Currently Chesapeake is managed as single species fisheries. There are attempts at trying to manage it as multi species fishery. Does not have to be species specific. Data requirements: biomass, production and consumption. ECOSIM, dynamic simulation tool, builds on ecopath.

**Hershner** pointed out that in the US people are more aware of their impact on aquatic habitats. Marine protected areas are emerging field of science.

**Benovic** asked about current key and indicator species in the Chesapeake Bay.

**Hershner and Bilkovic:**

Oysters – oyster population is very small today – restoration efforts – they are important for fisheries and as filter feeders.

Blue crab – moves in and out of the bay, there is no aquaculture of this species, they are trying to protect areas – thereby protecting species, hard to agree upon with fisherman, it has not been resumed yet.

Indicator species – ecological keystone species – reason for picking one – it's easy to find – thereby easy to measure. Submerged aquatic vegetation (SAV) – areal photography – important habitat area. Traditionally indicator species were selected based on likeliness of public, e.g.. larger species, sea bass

**Lay and Martinovic-Vukovic** talked on protected areas in this region: Mljet National Park, Mali Ston Bay, Neretva Delta, Elafiti, Lastovo.

**Lay** pointed on impact of a number of large cruise liner to Dubrovnik and tourism pressure on marine parks.

**Frankie** talked on a vision of development of this area. Can development be sustainable? What size of touristic activity do we need? What level do we want? What type of tourism? What are going to be locations or research problems that projects should include? Most previous research has been done in Mljet and Mali Ston Bay.

**Benovic** proposed two potential locations for the project. Mljet National Park where from a larger set of data exists. and Lastovo as a place where open hunting grounds exist for underwater spear fishing (mostly Italian tourists). Possible indicator species: red coral. Other needs to be from a group of floating organisms (jellyfish) (e.g. before there were 40 sp. of medusas in North Adriatic, now only 8 species – species that have strong benthic phase were eliminated due to bottom anoxia. Strong social component should be area under the research – that has something in common.

**Legovic** proposed: following sites 1. Mljet; 2. Mali Ston Bay, 3. the whole South Adriatic.

**Hershner** agreed that perhaps the whole area of the south Adriatic might be included. In Chesapeake Bay scientists consider biological end points.

**Benovic** agreed on Mljet and Mali Ston Bay as two case study areas. Emphasis on how marine currents, virtually unknown in this area, affect distribution of larvae.

More on the recent data will be displayed at the web page from the Institute R. Boskovic, Center in Rovinj: [www://more.cim.irb.hr/~precali/](http://www://more.cim.irb.hr/~precali/)

**Wednesday, October 9<sup>th</sup> 2002**

**Field trip to the island Mljet and the National Park Mljet; Research ship "Naše more"**

- visited one potential site for the South Adriatic project

**Thursday, October 10<sup>th</sup> 2002, morning session**

Topic: Elaboration of ideas on possible projects

**Benovic:** Croatian South Adriatic System (CSAS)

Proposal Region: South Adriatic, case studies: Mljet + Mali Ston Bay. Natural resources of S. Adriatic and social change.

Parameters needed:

- 1) Physical oceanography – water mass movement especially in case areas
- 2) Planktology – plankton data from the southern stations south toward north covering entire area. Focus on medusas as indicators of water movement.
- 3) Benthos suggested tracing some indicator species of shellfish and fish.

(**Dulcic** proposed fingerlings, not adults)

NSF source of funding was discussed, but others were mentioned as well. Themes: Changes in the environment due to global and local impacts. Links to social changes that came about as a result of natural changes. Mljet lakes: investigate efficiency of protection. Mali Ston Bay: investigate efficiency of usage of the sea.

Global and local impacts are affecting people's lives; hence knowledge on natural resources should be taken into account when constructing guidelines for development of the areas.

**Klasinc:** Proposal – Sustainable ecosystem management of the Croatian South Adriatic Region (CSAR). The complexity of physical, ecological and social processes taking place during the end of last century of rapid development in the Mediterranean region, confronts us now with the need to find a model region where still a sustainable ecosystem may be observed and from which we could learn how to manage it at the same time. Pursuing that, the proposed project CSAR, will deal with the dynamic interactions of biological, physio-chemical and coastal components in this environment and give suggestions how to preserve and manage it. Changes in the composition of atmosphere affect many aspects of life. For humans, climate change, radiation level, air quality, and deposition of chemicals are the most important since they affect human health, food and environmental quality. Climatic variability, air pollution and transport of air masses into the region will be addressed from the viewpoint of atmospheric chemistry studies. Such research has been well developed in this region. Therefore, on the basis of several years of photooxidants monitoring in Dubrovnik and along the Croatian coast, we will be able to extract and determine yearly and seasonal trajectories of air masses, which arrive at certain representative points of the CSAR. This will enable analysis of the interactions with other components of the ecosystem and determine the effects of air pollution. The contribution is offered by the LKKAK of the Rudjer Boskovic Institute in Zagreb.

**Legovic** Proposals:

- 1) Effects of incursions on biocomplexity in the coastal sea.
- 2) Quantifying biocomplexity dynamics in coastal areas: physical, biological, chemical, social and economic changes.
- 3) How changes in filter feeding community affect biocomplexity in coastal zone. Compare Mljet (baseline, natural) and Ston (affected by humans through creation of shellfish culture) and consequences for dispersal of larvae. How these affect natural filter feeding communities?

**Dulcic:** Many exotic species occur after periods of Adriatic incursions. Lot of species establish juveniles. Number of species is increasing. Abundances of certain species are decreasing. For pelagic fisheries we have data from 19<sup>th</sup> century. Today, pelagic fishery is 65% of total fishery.

**Peharda:** Presently there is a limited understanding of biodiversity in South Adriatic, except in a few limited areas. It would be essential to identify strategically important habitats. We have very limited understanding of benthic/pelagic coupling or supply side ecology, one of the things to potentially investigate. Dubrovnik is traditionally strong center for plankton ecology – any proposal should take advantage of that. In terms of benthic research, potentials exist to analyze bivalves (*Pinna nobilis*, *Lithophaga lithophaga* – date shell), sea grass meadows (distribution and maps), *Caulerpa taxifolia* and recently *Caulerpa racemosa* distribution and effects on change in biodiversity.

**Bilkovic:** Important to document biodiversity in coastal zone. Put that into spatial context – habitat suitability work with GIS – identifying important habitat areas & aquaculture areas. Indexes of habitat quality based on groups of organisms present. Develop model of sustainability – based on multiuse activities. How aquaculture activities have changed habitat.

**Dulcic:** There exist data for pelagic and demersal fisheries. Jukic mapped these fisheries since 1984. Hvar expedition (1948): these data can be regarded as data on virgin stock. There is a checklist of species for certain locations. These data are scarce for the south Adriatic

**Hershner:** Human dimension of biocomplexity is very important. Managing south Adriatic for biodiversity. Understanding endemic population. Willingness of people to participate in sustainable management. of Mljet. Social survey.

1. Mljet – inventory of biodiversity, life cycle of certain species, GIS mapping, social analysis – relationship between social and natural.
  2. More challenging and less feasible – Looking across entire area – distribution of habitat types, key species and habitat requirements. Overlay that with stressors in the ecosystem e.g. water quality, fecal coliforms. Risk associated with the use. Analysis of management strategies. Social – willingness to accept certain management strategy.
- Zero hypotheses – situation as it currently exists in Mljet is sustainable, so search for interactions that are not sustainable.

Experimental – comparison between park and rest of the island. Efficiency of protection. Investigation into fishing methods:

1. Biodiversity conditions – with some spatial scale
2. Local utilization of resources – land use, sea use, olives, agriculture – constructing social interaction model

Some biotic model of both ends of the island that incorporates social component. Develop economic feedback that can be identified.

Habitat suitability models: Direct and indirect link between species and humans; What local inhabitants value as good habitat – requires explicit interviews;

Also proposed to model changes in fish species and fishing gear;

**Baerwald:** Where are focused research questions? Scientific process of clearly identifying problems, emphasis on data. Question of associations, need to go deeper than that. Understanding processes – cause and effect relationship. Biocomplexity – important process level, not association.

Coupled natural and human system – where are the people? It was seen a little bit in a last part of discussion. Important to look also on the land. What about social systems on the land.

Socio-economic system is far more than management. Management of people is not what you are aiming at.

Other possible topics: bio-geo-chemical cycles (deadline in a couple of months). Also, biological oceanography program runs two competitions a year. Question of biotic inventories is of relevance only to freshwater proposals (saltwater is under GEO sciences). Also, population biology program;

NSF wants publications in Science and Nature;

**Frankie:** Important involvement of local community from the beginning of project development, and capacity building. Establish process/mechanism of exchange of students/young experts between Croatia and the USA;

#### **Thursday, October 10<sup>th</sup> 2002, afternoon session**

**Frankie:** 1. There is a yearly NCSE/NSF conference in D.C. (January 30-31.2003). We would like to bring a few young people to attend it and visit VIMS on the same occasion. [www.ncseonline.org/conference](http://www.ncseonline.org/conference)

Pursue more concrete collaboration. Post doc possibilities; and need to identify roles in potential projects.

2. University of Rhode Island, Coastal Resources Center – has summer institute for coastal management. The next one is scheduled for 2004 (held every two years). Provides a one-month of training and education. Supported through the USAID.

3. Dubrovnik as a regional center for education in coastal management. It could cover every second year that it is not in Rhode Island? It has been identified (for to many times) that there is a need for education in applied sciences and coastal management in Croatian and the whole Adriatic region!

**Proposal: Graduate Study in Coastal Environmental Management;** and exchange of graduate students, young experts between the US and Croatia.

**Hershner:** Concept of young colleague exchange. Interested almost immediately. Need to locate funds. Even shorter term – summer study course – to become familiar with approaches, analytical methods. Identify small pieces of project that can be done as student projects. It could move the whole project forward. Capacity exists for accepting a student, almost immediately.

**Benovic:** Framework for future higher education in Mediterranean oceanography, coastal zone management within the Polytechnic of Dubrovnik (soon University). In two years we will probably have a M.Sc. program in environmental management in Dubrovnik, so now is the appropriate time to get involved.

A discussion took place on needed steps to move the concept toward implementation. It was agreed to collaborate on formulation of a proposal that could be used to approach funding agencies.

#### **Friday, October 11<sup>th</sup> 2002. Visit to the Bay of Mali Ston.**

- Mali Stone bay is located near the border with Bosnia and Hercegovina; it is a reserve site that still continues with historical shellfish aquaculture activity; also a potential site for the project;

**Attachment 3**  
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## Attachment 4

### General description of the Croatian coast and islands

Croatia has 1,246 islands and they are divided into 79 islands, 526 islets, and 641 reefs and rocks. All together they represent just 5.8% (or 3,300 km<sup>2</sup>) of the Croatian land, but 70% of total Croatian coastline (4,057 km of 5,835 km), while 20 islands exceed 20 km<sup>2</sup> (Leder, et al, 2000). Only 48 islands are permanently inhabited, and 100 are considered occasionally inhabited. Average island settlement has 417 inhabitants, although the largest town Mali Losinj (North Adriatic area) has 6,566 (1991 census). Islands experience Mediterranean climate, with mean annual temperature of 15°C and approximately 2,500 hours of sunshine a year, and average annual precipitation between 889-977 mm. Croatian islands (except Brusnik and Jabuka) are all part of the karst relief, built of Cretaceous sediments deposited in a form of carbonate platform (BSAP, 1999). Specific geological processes formed so called **Dalmatian type of coast**, with parallel spreading of coastline, hinterland mountain ranges, and island chains. By the end the last glaciations (10,000 years ago), the sea level rise of 100 meters and tectonic motions separated islands from the mainland. Today's lines of the islands are tops of former mountain ranges, and the general trend of geological structure is 'Dinaric direction'. The product of limestone weathering is '*terra rosa*', red soil colored from the conversion of hydrated ferric oxides to hematite. Such a soil and lack of water on the islands allow just a poor agriculture: small vineyards, olive grove, sheep and goat pasture. But coastal, and submarine karst environment is ideal for fishery, recreation, diving, and nautical tourism.

Biogeographical position of Croatian coast and islands, the dominating geological base (limestone), a distinctly karst relief, the indentation of the coast and islands, and the fact that this area was a sanctuary for plants and animals during the Ice Age, resulted in outstanding coastal biodiversity and uniqueness of flora and fauna. Peculiarities include predominantly stony limestone coast (karst relief) with gravelly and rare sandy beaches, endemic flora of coastal rocks, endemic flora and fauna of the islands, endemic underground fauna, rivers of the Adriatic catchments area with endemic fauna (fresh-water fishes), Mediterranean marshes and natural lakes (BSAP, 1999). Due to their karst hydrogeology, and geomorphology, Croatian islands and marine ecosystems are extremely rich in fauna of diverse habitats, including the interstitial fauna, fresh-water and terrestrial species inhabiting numerous caves and pits, as well as deepwater coral reefs habitats. The most numerous *endemic plant species* can be found on small off-shore islands, and cliffs of Dalmatia's islands facing south and south-west. Ecosystems of the Croatian islands and surrounding sea have also been recognized internationally as extremely valuable and rich in biodiversity, as well as in their cultural heritage.

### Why South Adriatic Region?

The Adriatic Sea is a gulf of the Mediterranean Sea lying in the southeast-northwestern direction into the length of 783 km, with the surface area of 38,595 sq. km at the mean sea-level. The Adriatic is a shallow sea, with the greatest depth not exceeding 1,330 m and the mean 173 m. The depths of up to 200 m (continental shelf) occupy as much as 73.9 p.c. of the Adriatic sea bottom. Depths exceeding 200 m may be found in the depression of the island of Jabuka and of the south Adriatic. In general, it is a low productive, oligotrophic sea, but it is more productive along the coast and in the area of channels than in the open sea. However, due to various specific influences Northern Adriatic is considered a highly productive region, one of the most productive in the Mediterranean Sea. The low level of organic production in the Adriatic Sea is a result of a low content of nutritious salts in water, of phosphorus and nitrogen in particular.

The Adriatic Sea is a very sensitive system, both as a physical and as a bio-geo-chemical environment. The physical component of the Adriatic Sea system depends on one hand on the buoyancy accumulated in the water column, and on the other hand it is conditioned by the air-sea buoyancy exchange and by the buoyancy input via riverine freshwater discharge. The Adriatic Sea has a peculiar property that is characterized both by the estuarine circulation type and by an anti-estuarine circulation

pattern in the Strait of Otranto. These properties are mirrored by biological species that are present along the coasts and in the pelagic systems of north, middle and south Adriatic.

The South Adriatic Pit is a portion of the Adriatic Sea where dense water formation takes place via an open-ocean convection. This is an oligotrophic area and a spring phytoplankton bloom is triggered by nutrient injections into the euphotic zone by the winter convection. Therefore, to some extent, the spring primary production maximum should be associated to the intensity of the deep-water formation processes. The winter heat losses strongly change on interannual time-scale resulting in a variable convection depth, which then determines the nutrient input into the euphotic zone and thus the new and export production. The vertical carbon flux data interpreted with remotely sensed algal biomass and *in situ* nutrient data suggest that the interannual variations of the Southern Adriatic open-sea spring bloom are indeed associated mainly to local winter climatic conditions.

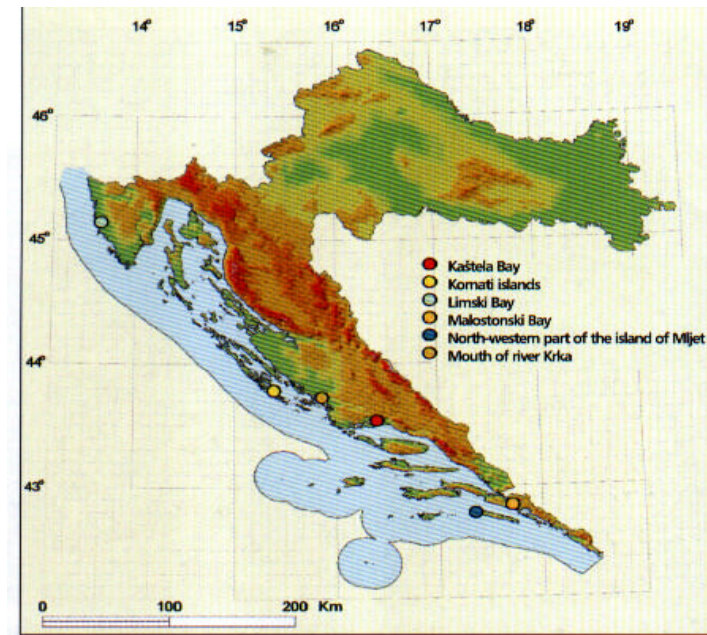
Correspondence of the high-chlorophyll content patch and the center of the cyclonic gyre confirms that the intermediate high-nutrient content water advected from the Eastern Mediterranean, is vertically mixed in the center of the Southern Adriatic by winter convection and dense water formation processes. Sometimes, mild winter results in a complete absence of the vertical convection and, in these conditions the spring phytoplankton bloom in the open-sea area should be determined by other mechanisms such as the exchange with the nutrient-rich coastal waters and the large-scale vertical mixing. The new production estimated from the amount of nutrients made available to the phytoplankton by mixing over the convection depth is in a good agreement with the sediment trap data, confirming the predominant role of local winter climatic conditions in the Southern Adriatic biological pump. It was also evidenced that the spring bloom undergoes high-frequency weekly time-scale variability as determined by strong heat loss events on the synoptic time-scale. In fact, the spring algal bloom maximum consists of a series of short-term high-production episodes associated with the calm weather periods, which typically take place after the violent mixing events and transient nutrient injections into the euphotic zone. The total spring primary production, which is to a large extent a new production, represents then the sum of these single bloom events.

This high-frequency pulsating mode of the spring phytoplankton bloom in the Southern Adriatic requires the high-resolution biological sampling in order to resolve short time-scales associated with the open-sea convection and events in the local meteorological forcing function. Interannual variations of the intensity of the vertical convection cause changes in the dense water volume formed. Dense water outflow measurements in the Strait of Otranto revealed interannual variations of the flow rate ranging from 0.1 to 0.4 Sv, which agreed perfectly with the winter climatic conditions: mild winters result in a weak outflow, while severe winters generate strong bottom water outflow in the Strait of Otranto. These characteristics make the South Adriatic Pit and the Strait of Otranto key areas for the long-term monitoring of the variations of the sea response to interannual climatic variability. This monitoring should be interdisciplinary and should include some key biological and chemical parameters in addition to physical oceanography components.

Because of water mixing and sea currents that shift major portions of water masses from the south toward north Adriatic areas, bio-geo-chemical properties of the South Adriatic have major role in the behavior of other Adriatic zones. On the contrary, the South Adriatic area is less researched than other zones, and consequently has poor database of biodiversity and other components necessary for the biocomplexity project. The South Adriatic Region and the biocomplexity project will include area between Bay of Kotor and the island of Lastovo. In this area there are island of Elaphits, the National Park "Mljet", sea-reserve Bay of Mali Ston and the Neretva rivermouth.

The south Adriatic area has been identified by the Conservation International as one of the 25 hotspots to be preserved globally (CI, 2001). In addition, recently completed WWF Mediterranean Gap Analysis identified Dalmatia as one of 13 key priorities in the Mediterranean to be conserved and protected. The Government of Croatia identified this area as one of the six most ecologically valuable and threatened areas in Croatia (see Fig 1.).

Fig. 1. Ecologically vulnerable and threatened areas of the Adriatic area



### Socio-economic aspects

This whole area has experienced profound demographic changes over the past decades, due to the war and post-war circumstances, decline of socio-economic opportunities (education, employment, etc.) and increased level of poverty. Population density is extremely low, and it remains very old (average 64). Other problems include isolation and dispersion of the islands area, singularity of most islands, poor natural resources regarding soil types, lack of water, dry summers, inadequate government policy, socio-geographical and economic decrease due to collapse of sailing, fisheries, handicrafts, schools, deagrarization, etc.

Underutilization of resources and the proverbial lack of a labor force causes agriculture, the oldest and until recently the most important economic activity of this part of the Croatian islands, to rank very low in terms of economic priorities. Viticulture, for centuries the most important agricultural branch, does not produce any surplus and hardly meets the needs of the local population. The tradition of growing and gathering medicinal herbs has also died out. Growing olives, for which there are very good natural conditions, is gaining in importance as an economic activity. Sheep breeding, which is complementary to olive growing, is also increasing. However, while islanders are good producers, there is a lack of products processing and marketing. In spite of truly ideal resources for numerous Mediterranean crops, which if grown could complement upscale tourism. There is a need for establishment of farming cooperatives that would create incentives for gathering the remaining farmers together, recruiting new ones and provide conditions for a modern, organized farming activity.

While suitable, in terms of its resources, for high quality tourism, this area has been providing lower quality services when compared with other islands or the Croatian coast. However, based on its natural and cultural heritage this area has numerous potentials for prosperous and sustainable socio-economic development.

Over the past 2-3 decades the natural and cultural heritage has been increasingly neglected, disintegrated and forgotten, causing off balance and threat in once maintained harmony between natural and traditional life and customs. In planning and developing a biocomplexity project we should

specifically emphasize and address social and economic elements and needs for integrated resources management and sustainable development plan (or ICZM).

### **Integrated coastal zone management (ICZM)**

Croatia needs an ICZM plan that will help combine all aspects of the human (socio-economic), physical and biological factors of the coastal areas within a single management framework. One of the main aspects and goals of the proposed biocomplexity project is to emphasize holistic and interdisciplinary approach in careful planning and management of all sectoral activities. This approach should simultaneously result in greater overall benefits than just pursuing sectoral development plans independently of one another (e.g. agriculture, tourism, aquaculture, fisheries, education, etc.). Islands and coastal ecosystems sustainable development strives to maintain or restore a balance between natural and human environments. Therefore, sustainable development in this project will involve management in time and space of the constant interactions between ecological and economic, and social and natural variability, supporting co-existence of ecosystems and lifestyles side by side. Natural and cultural components of the islands heritage are inseparable and could not be addressed independently of each other, neither in development planning or conservation efforts.

ICZM plan for sustainable development will include careful consideration of a multiplicity of parameters and their interactions. Adequate policy must address the resolution of potential conflicts, which is often hindered by lack of information or appropriate methodologies. Planning for sustainable uses must be a process that comprehensively and holistically analyses islands and coastal systems: natural resources conditions, human uses and socio-economic aspects. Socio-economic sector conflicts can be managed simply by controlling where certain activities are undertaken (e.g. different types of agriculture, tourism, aquaculture, fisheries, etc), but sustainability can only be attained when environmental conditions are appropriate. This means that choices should be based on environmental requirements and suitability for the activity and the activity's interactions with the environmental resources. Site suitability assessment and implementation must incorporate socio-economic, and cultural factors. Although, the Croatian Government has the responsibility to determine the appropriate balance of resource preservation and utilization of the island areas, decisions should be based on interests and participation of the local communities. Therefore, important parts of the ICZM process are actions at the local level. All stakeholders must be able to participate in the planning process to ensure that it is as equitable as possible, and that they understand the connections between different elements of the process and understand how their actions can contribute to the achievement of the common good or vice versa. Therefore, this project will aim to improve and increase sustainable economic opportunities and social cohesion in the South Adriatic region.

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## Attachment 5

### Itinerary for visiting Croatian scientists

***Prof. T. Legovic, Institute Rudjer Boskovi, Zagreb and  
Dr. M. Peharda-Uljevic, Institute for Oceanography & Fisheries, Split***

January 27- February 6, 2003  
(Supported by the NSF Grant)

**Monday, January 27, 4 pm** – Arrival at Washington Dulles airport, drive to Hotel Best Western Pentagon, 2480 South Glebe Road, Arlington, Phone: 703-979-4400

**Tuesday, Jan 28 - 10-12:00 am** – meeting with USAID (dr. Barbara Best, Ms. Luba Fajfer, Ms. Anne Convery, Mr. Martin Hewitt)

**Wednesday, Jan. 29 – 10:00 am** - meeting at NOAA, Silver Spring with Mr. Charles Ehler (director of coastal management and international departments) and prof. Biliana Cicin-Sain, check this web site: <http://www.udel.edu/CMS/csmp/pages/network.html>

**2:30 pm** - meeting with NSF team: Ms. Bonnie Thompson (Program Manager, International Science and Engineering), Jeanne Hudson (Regional Coordinator, Western Europe), Alexandra Stepanian (Regional Coordinator, Central and Eastern Europe), Tom Baerwald (Program Director, Geography and regional sciences), Robert O’Conor (Program Director, Decision, Risk and Management Sciences), Phillip Taylor (Program Director, Biological Oceanography), and Henry Gholz (Program Director, Long-term Ecological Research)

**Thursday, Jan 30 – 8:30 am-7 pm** - NCSE Conference at Reagan Building and International Trade Center, 1300 Pennsylvania Avenue, evening reception,  
Meeting with dr. Rita Colwell

**Friday, Jan 31 – 8:30 am- 7 pm** - NCSE Conference, evening reception

**Saturday, Feb 1 – 8:30 am – 4:00 pm** Dean & Directors meeting, at Willard Inter-Continental Hotel, 1401 Pennsylvania Av.  
Saturday evening leaving for Williamsburg. Staying at my house.

**Monday, Feb 3 – 8:30 am** – meeting at VIMS, Center for Coastal Resources management, this is also our monthly meeting; you will briefly learn what we do  
<http://ccrm.vims.edu/>

**2:00 – 3:00 pm** – presentation time (T. Legovic)

**Tuesday, Feb 4 – 9:00 am** – meeting with Marcia Berman, CCRM/VIMS

**1:30 – 4:00 pm** Workshop with Dr. Harry Wang and hydrogeological modeling team (VIMS), and Dr. Ralph Cheng (USGS), on UnTRIM 3-D modeling application on Adriatic region;

**Wednesday – 12:00 pm** – pot-luck lunch, morning meetings with several VIMS scientists

2:00 – 3:00 pm presentation time (M.Peharda-Uljevic)

Concluding meeting with Dr. Carl Hershner, Director of CCRM/VIMS

**Thursday – 11:00 am** – meeting with the Croatian Ambassador, Dr. Ivan Grdesic, Croatian Embassy, Washington DC

3:00 pm – leaving for Washington Dulles airport, 5:45 pm departure

## *Izvjescje – Croatian Study Visit Report*

Posjet Sjedinjenim Americkim Državama, koji je organizirala dr. Anamarija Frankic, je trajao od 27.01. do 07.02.2003. U sklopu posjeta prof. dr. Tarzan Legovic, dr. Frankic i ja smo imali nekoliko sastanaka sa federalnim agencijama u Washington D.C. vezano za ispitivanja mogucnosti izrade zajednickih projekata za znanstvena istraživanja i edukaciju. Putovanje je bilo nastavak radionice održane prošlu jesen u Dubrovniku ( na kojoj su donešeni zakljucci o pripremama i pokretanju medunarodnog poslijediplomskog studija iz podrucja zaštite i upravljanja prirodom (Graduate Environmental Management School) te pripreme Biocomplexity projekta za podrucje južnog Jadrana koji bi se predložio za financiranje National Science Foundation (NSF).

Dana 28.01. imali smo sastanak u USAID sa nekoliko predstavnika ove organizacije ukljucujuci dr. Barbaru Best, dr. Ljuba Fajfer, dr. Alicia Grimes i dr. Martin Hewitt. Naglašena je važnost traženja izvora financiranja projekata sa razlicitih stana ('leveraging funds') te podrška misije USAID-a u Zagrebu. Dane su nam smjernice za pripremu projekata za razvoj studija i razmjenu profesora i znanstvenih strucnjaka.

Dana 29.01. prijepodne smo imali sastanak u NOAA medunarodnom odjelu. Domacin sastanka je bio Charles Ehler (Direktor odjela za Medjunarodnu suradnju i Direktor odjela za Upravljanje Obalom –CZM), i prof. dr. B. Cicin-Šain (Direktorica skole za Marine Policy, University of Delaware). Naglašena je spremnost NOAA-e da pomogne razvoju polijediplomskog studija sa svojim strucnjacima. Nadalje, navedena je mogucnost studentskih praksi za hrvatske studente u okviru ove organizacije.

Poslijepodne 29.01. smo imali sastanak u NSF-u sa dr. Bonni Thompson (project manager, central and eastern Europe program), dr. Jeanne Hudson (regional coordinator, western Europe), dr. Alexandra Stepanian (regional coordinator, central and eastern Europe), dr. Robert O'Connor (program director, decision, risk and management services), i dr. Phillip R. Taylor (program director, biological oceanography). Na sastanku je pokazana velika zainteresiranost za projekte vezane za južni Jadran te su nam dane smjernice za pripremu projekta. Naglašeno je da NSF ne daje sredstva stranim institucijama vec da su sredstva namjenjena prvenstveno za Americke sudionike na projektu. Medutim, napomenuto je da se sredstva od moguceg projekta mogu koristiti za nabavku razne opreme (npr.oprema na brodu, laboratorija, instituta, i sl.) te za placanje studenata na doktoratima i postdoktoratima bez obzira na njihovu nacionalnu pripadnost. Iznosi za do sada odobrene biocomplexity projekate kretali su se od nekoliko stotina tisuca dolara do nekoliko milijuna dolara, u trajanju od jedne do tri godine.

U cetvrtak i petak (30. i 31.01.) smo sudjelovali na medjunarodnom kongresu o važnosti edukacije za održivi razvoj i sigurnu buducnost koji je organizirao national Council for Science and Environment (NCSE). Tijekom kongresa smo upoznali predstavnike desetak fakulteta i upoznali ih sa planom otvaranja poslijediplomskog studija iz Environmental Management. U subotu (1.2.) smo u skopu nastavka kongresa sudjelovali, kao prvo medunarodno izaslanstvo, na sastanku Dekana i direktora sveucilišta koji imaju programe iz podrucja znanosti o okolišu ili zaštite i upravljanja okolišem. Na sastanku smo predstavili planirani studij, što je pobudilo poprilicno zanimanje, ukljucujuci i mogucnost suradnje sa sveucilištom Yale.

Slijedeći tjedan posjet je nastavljen u Virginiji na Virginia Institute of Marine Science (VIMS) gdje smo održali seriju razgovora sa znanstvenicima iz različitih odjela vezano za mogućnosti izrade Biokomplexity projekta za južni Jadran. Dogovoreno je da kao rezultat provedenih razgovora, dr. Anamarija Frankić napiše radnu verziju prijedloga mogućih projekata. Na VIMS-u smo prof. dr. Tarzan Legović i ja održali predavanja o djelatnostima naših instituta i našim istraživanjima.



Dubrovnik view from mountain Srdj



Dubrovnik workshop participants on the Mljet island.