A. Kontogianni, E. Papageorgiou,
B. Zannou, D. Castilla, F. Adaman,
V. Melikidze, L. Salomatina,
E. Papathanassiou, & M. Skourtos

Assessing perceptions of environmental futures through Fuzzy Cognitive Mapping

Human perceptions for supporting native biodiversity and resilience of marine ecosystems:

5 case studies with Mediterranean and Black Sea stakeholders

POLICY RELEVANCE

Is it really necessary our research to prove PR?

What it has to do with science?

How is this successful? (the track from science to policy making)

POLICY ANALYSIS OF MARINE CONSERVATION PROGRAMMES

Bottom-up and top down approaches

What is a stakeholder?

Stakeholders are persons, groups or institutions with interests in a project or programme.

What is stakeholder analysis?

Stakeholder analysis is the identification of a project's key stakeholders, an assessment of their interests, and the ways in which these interests affect project riskiness and viability. ‘Interest’ has an economic meaning, but is also linked to both institutional appraisal and social analysis.

What is Governance?

Governance is the interactions among institutions, processes and traditions that determine how power is exercised, how decisions are taken on issues of public and often private concern, and how citizens or other stakeholders have their say.

Fundamentally, governance is about power, relationships and accountability: who has influence, who decides, and how decision-makers are held accountable.

Why new models of Governance?

Governments are seeking to implement their policies and programs in a more cost-effective, responsive and equitable manner to increase overall social benefits.

Citizens are demanding more influence on decisions affecting their lives and, as appropriate, the re-adressing of past injustices

A PERFECT RESPONSE TO GOVERNMENT POLICIES?

CITIZENS'

COMPLIANCE RATE!!

HOW IS THIS MAXIMISED?

A PERFECT RESPONSE TO GOVERNMENT POLICIES?

BOTTOM UP APPROACH:

POLICIES IN WHICH CITIZENS PARTICIPATE IN THEIR FORMULATION ARE SUCCESFULLY IMPLEMENTED AND ENJOY HIGH COMPLIANCE RATE!!

MAIN OBJECTIVE WITHIN SESAME STAKEHOLDER ANALYSIS:

DE-CODING OF STAKEHOLDER PERCEPTIONS ON SES MARINE PROTECTION POLICY ISSUES..

Evaluating the governance of a Mediterranean marine area

SESAME OBJECTIVE WITHIN STAKEHOLDER ANALYSIS

SESAME GOAL OF 200 QRES AND FOCUS GROUPS WITH STAKEHOLDERS WERE ALREADY IMPLEMENTED EARLY IN 2009!

BUT…

The main problem of stakeholder analysis

Linguistic and cultural differences among stakeholders and researchers.

By translating three times the stakeholders' concepts we loose information and enlarge uncertainty within the modeling of stakeholders beliefs

The main problem of stakeholder analysis

Usual methods employed: Qualitative techniques: focus groups, content and discourse analysis, biographical method

How can we overcome this problem? By employing a technique to semi-quantify the fuzziness of stakeholders' beliefs & perceptions

SESAME
Southern European Seas: Assessing and Modelling Ecosystem changes

SO

IN MAY 2009 WE STARTED A NEW STAKEHOLDER ANALYSIS EMPLOYING A NEW METHOD [FCM] AND WE APPLIED IT IN 5 COUNTRIES:

GEORGIA AND UKRAINE FOR THE BLACK SEA, SPAIN, GREECE AND TURKEY FOR THE MEDITERRANEAN

DEVELOPMENT OF METHODOLOGICAL GUIDE

GUIDELINES (II) FOR APPLYING COGNITIVE MAPPING METHODOLOGY TO SESAME PROJECT /SUBTASK WP7.2.2/15-5-2009

CONTENTS

1. What kind of information do we want?
2. From whom do we need this information?
3. How many people we interview and how?
4. Do we need a common protocol for applying cognitive mapping to different Countries?
5. Do we need a common form of reporting the results?
6. What are the deliverables at the end of the (national) cognitive mapping research?
7. What is cognitive mapping methodology?

SESAME

A.Kontogianni, M.Skourtos
(not to be circulated without authors' permission)

GUIDELINES (I) FOR APPLYING COGNITIVE MAPPING METHODOLOGY TO SESAME PROJECT /SUBTASK WP7.2.2/15-5-2009

You are strongly advised to use personal interviews, i.e. to interview each participant alone, especially during the beginning of applying the method. That is because each one of the interviewed has to explain to you the way he is thinking in order to produce his map and you need to take detailed notes, which (I hope clearly written!) will be sent to me. In **bold letters** below is the text which should be read to respondents exactly as it is, the other text is applied to you.

PART A. Preparation before meeting: MATERIALS: You will need

1. A4 pages (at least 5 blank pages in front of each participant + a pencil and a pen,
2. a printed copy of the questionnaire with the socio-economic data of the participant translated into your language (to be filled by each participant),
3. a printed copy of the example cognitive mapping (public health study), translated into your language
4. the printed photos of the invasive species and the printed information about those species,
5. plus the cognitive mapping protocol (present text)and the printed one page with the 12 grade scale.
6. please read carefully also the GUIDELINES II

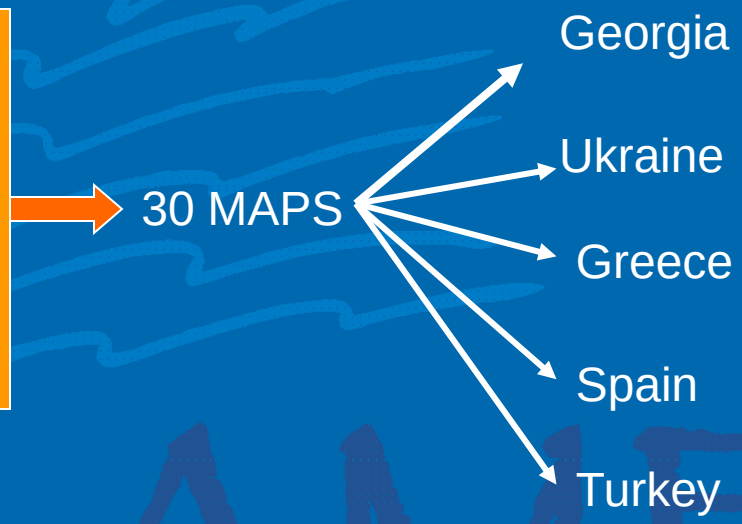
In case you prefer using your computer to show the relevant material to respondents be sure that you have with you in your computer the above mentioned files. It would be nice if we could include in our final report at least one photo of an interview from each country.

PART B. Cognitive mapping protocol

1. Meeting the participant, some relaxation drinking coffee/ juices, generally speaking about the weather etc.
2. Introduction
   Good morning and welcome to our today meeting. We appreciate a lot that you devote time to participate in our research. My name is ..., I am Professor/researcher responsible for this research. During our discussion I would like you to remember that there are no wrong or right answers, there are simply different opinions, which we encourage you to express freely.

Main Research Topics

Main factors affecting future state of marine ecosystem Black Sea/Mediterranean



Total 240 maps / 90 minutes each personal interview

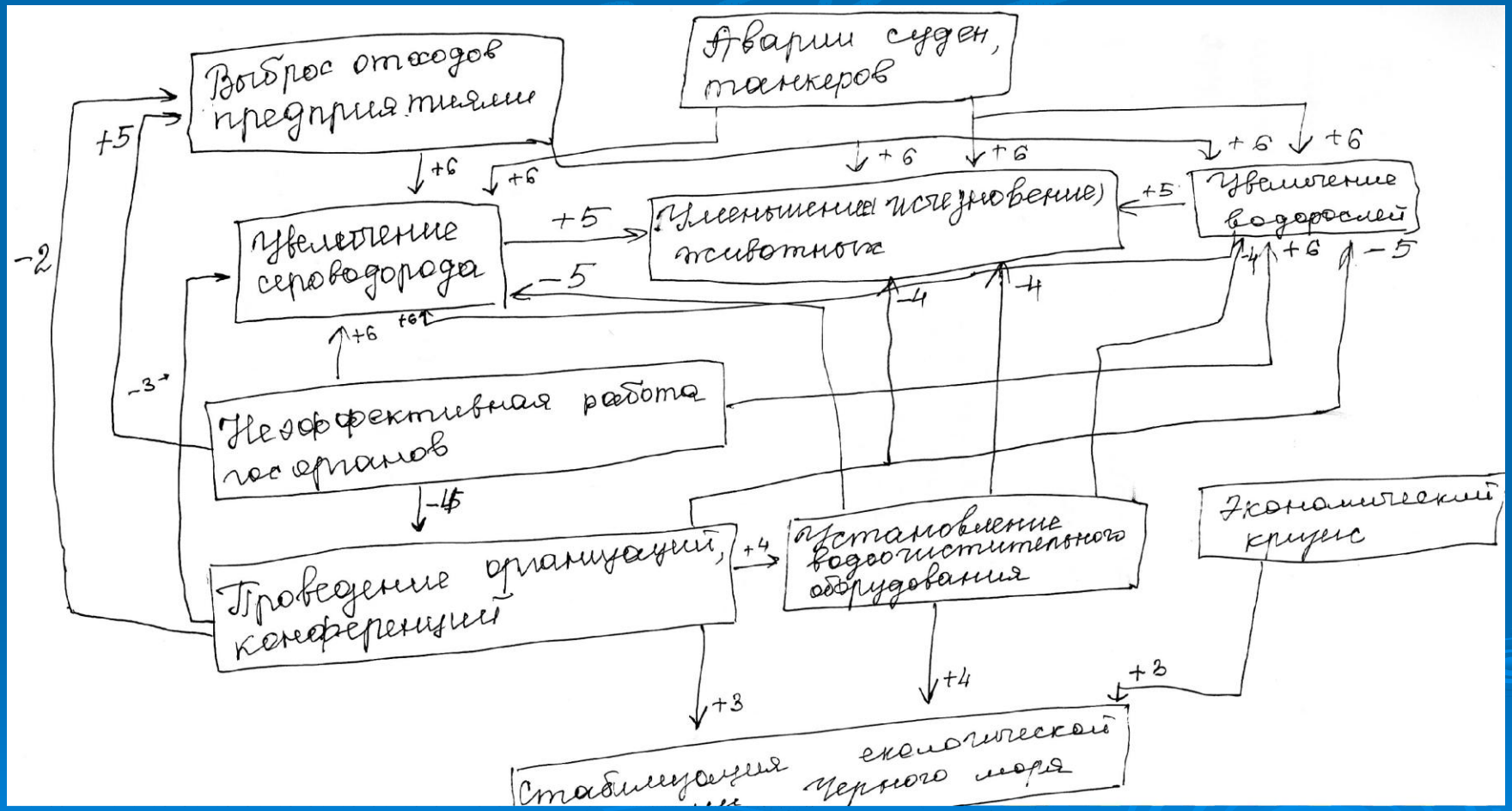
Invasive Species

USE OF FUZZY COGNITIVE MAPPING

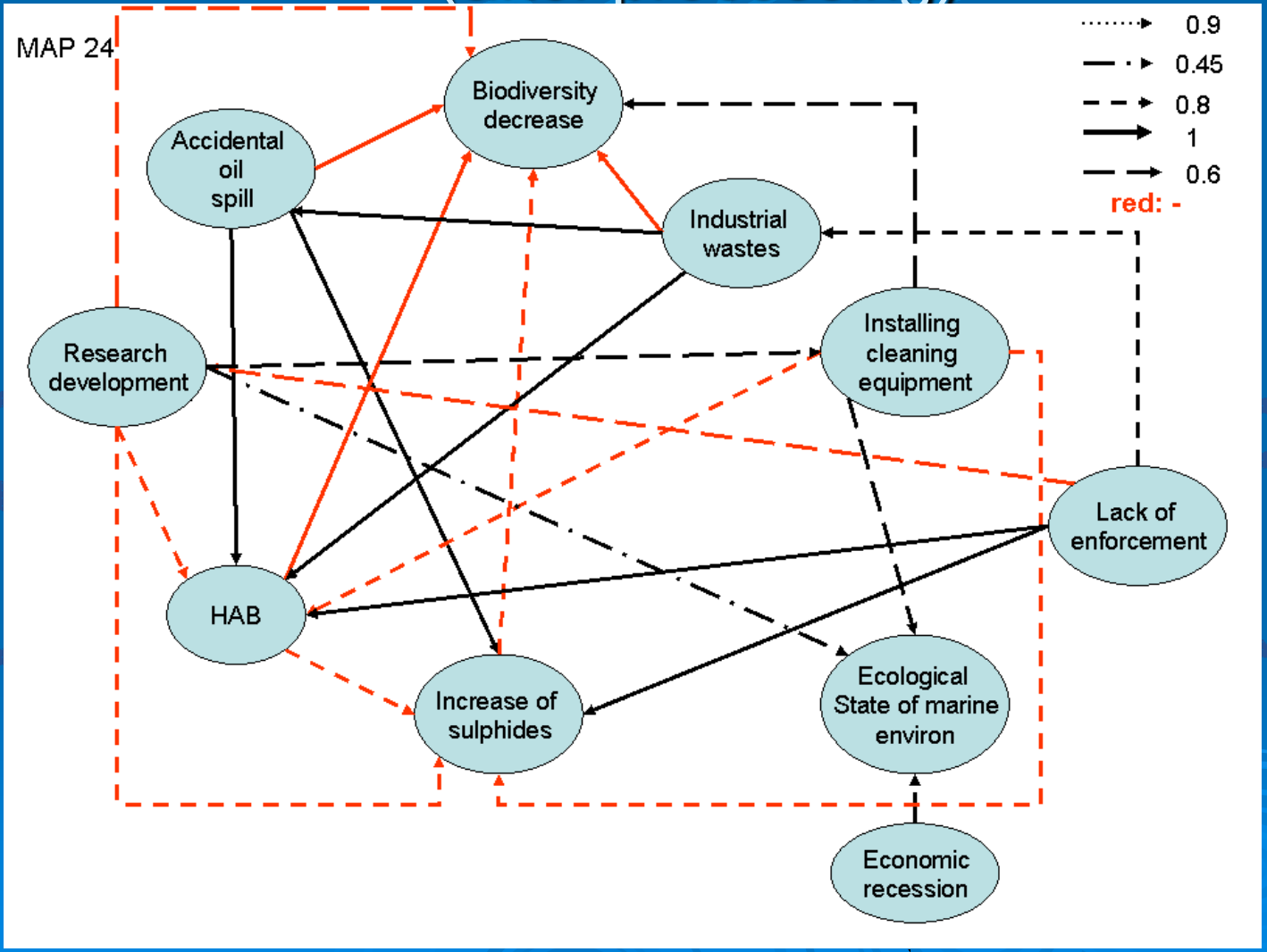
FCM methodology is used for knowledge elicitation, modelling and reasoning of lay people from SES describing the *main factors affecting the future of Mediterranean and Black Sea marine environment*.

A generic model for environmental management was constructed by augmenting the individual FCMs drawn by lay people-stakeholders from Spain, Greece, Turkey, Ukraine and Georgia.

Individual Cognitive Map
(before processing)



Individual Cognitive Map (after processing)



COGNITIVE MAP REPORT No 24 (out of 30)- Ukraine (Black sea)

PARTICIPANT NAME: Matvienko A.I.

DATE OF INTERVIEW: 11/6/2009

PLACE OF INTERVIEW: Crimea, Sevastopol

DIFFICULTIES DURING PROCEDURE:
-
WAS USE HARDWARE MATERIAL

COGNITIVE MAP: BLACK SEA

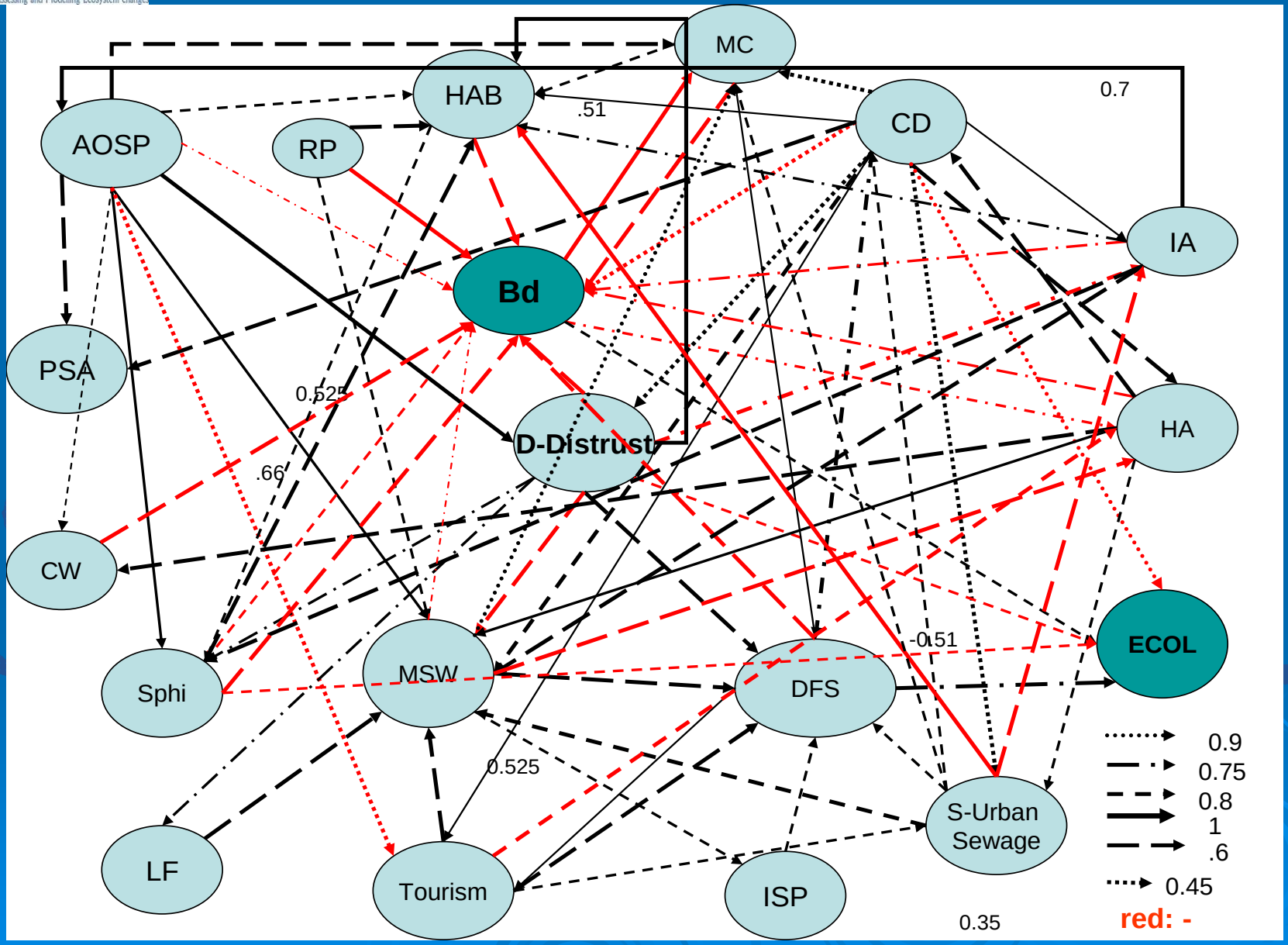
MAIN FACTORS SHE IDENTIFIED:

A. INDUSTRIAL WASTES (ОТХОДЫ С ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИЙ)
B. SEA POLLUTION FROM SHIP ACCIDENTS (ЗАГРЯЗНЕНИЕ МОРЯ В ПОСЛЕДСТВИИ АВАИЙ СУДОВ И ТАНКЕРОВ)
C. SULFIDES AND INCREASE OF IT (СЕРОВОДОРОД И ЕГО УВЕЛИЧЕНИЕ)
D. DECREASE IN THE NUMBER OF ANIMAL AND PLANT SPECIES (СОКРАЩЕНИЕ ВИДОВ ЖИВОТНЫХ И РАСТЕНИЙ)
E. ALGAE INCREASE (УВЕЛИЧЕНИЕ ВОДОРОСЛЕЙ)
F. CONDUCTING CONFERENCES ON ECOLOGY (ПРОВЕДЕНИЕ ЭКОЛОГИЧЕСКИХ КОНФЕРЕНЦИЙ ПО ЧЁРНОМУ МОРЮ)
G. INSTALLING CLEANING EQUIPMENT (УСТАНОВЛЕНИЕ ВОДООЧИСТИТЕЛЬНОГО ОБОРУДОВАНИЯ)
H. ECONOMIC CRISIS THAT LED TO THE DECREASE OF PRODUCTION VOLUME AND WASTES DECREASE (ЭКОНОМИЧЕСКИЙ КРИЗИС ПРИВЁЛ К УМЕНЬШЕНИЮ ОБЪЁМОВ ПРОИЗВОДСТВА , УМЕНЬШЕНИЕ ВЫБРОСОВ ОТХОДОВ)
I. UNEFFICIENT WORK OF GOVERNMENT AS TO ENVIRONMENT PROTECTION (НЕЭФФЕКТИВНАЯ РАБОТА ОРГАНОВ ГОС ВЛАСТИ ПО ОХРАНЕ СРЕДЫ И СОБЛЮДЕНИЮ ПРАВИЛ ПРЕДПРИЯТИЯМИ)
J. STABILISATION OF THE ECOLOGICAL SITUATION OF BLACK SEA (СТАБИЛИЗАЦИЯ ЭКОЛОГИЧЕСКОЙ СИТУАЦИИ ЧЕРНОГО МОРЯ)

DOCUMENTATION FOR DIRECTION OF ARROWS:
Conducting conferences on ecology and installing cleaning equipment positively affect negative factors and decrease consequences

DOCUMENTATION FOR STRENGTH OF INFLUENCE (GRADES):
A to C= +6, A to D= +6, A to E= +6, B to C = +6, B to D = +6, B to E = +6, E to D = +5, C to D = + 5, I to C = +6, I to A = +5, I to F = -4, I to E = +6, F to A = -2, F to C = -3, F to J = +3, F to G= +4, F to D= -4, F to E= -5, G to D= -4, G to C = -5, G to E = -5, G to J = +4, H to J = +3, E to C = -5

STRONG WORDS/ PHRASES SHE USED:
Sulfides and increase of it, algae increase, fish decrease


MC
HAB
.51
0.7
AOSP
RP
CD
IA
Bd
PSA
0.525
D-Distrust
HA
.66
CW
ECOL
-0.51
Sphi
MSW
DFS
0.525
S-Urban Sewage
LF
Tourism
ISP
0.35
0.9
0.75
0.8
1
.6
0.45
red: -

Concepts	Description of concepts	Stakeholders' original expressions
AOSP	Accidental oil spill pollution	Crashes of tankers and the ships, surface covering by the oil film, Accidental oil surface pollution.
Tourism	Tourism	Increase in tourists during a season, Atmosphere and environment pollution, Prompt development of recreational economy, Recreation
PST	Pollution of Sea Trade	Bad condition of old ships, Navigation, Polluting with fleet functioning results
CD	CD=Coastal Development	Beach garbage, Industrial enterprizes at the coast, industrialization, Development of scientific and technical process of industrial character, Replanning of sea coast, Coal terminal construction, Location of railway road on seacoast, Urbanization, Location of highways, parking on seacoast, Land use change, Molls that prevent water renewal, Large number of peers, building activity, Excessing building at the costal area, Landscape change, Coastal building, Population growth at the costal area, increase of population
BD	Biodiversity	disappearance of some species of marine plants and animals, Disappearance of many forms of sea animals, Reduction of number and forms of sea inhabitants, Reduction of sea animals and Algae, Reduction and disappearance of some forms of fishes, animals, Destruction of sea animals and plants, Destruction of sea flora and fauna, Disappearance of kinds of fishes and seaweed, Reduction of number of sea inhabitants, Change of biocenosis, Brown algae decrease
ChemW	Chemical wastes	Chemical substances in the sea, Chemical pollutants
D	Distrust to State & Institutions	Insufficient number of controlling institutions, Default of legislation, Low Human Culture level, Absence of monitoring systems of the industrial wastes, No control from the government as to environmental protection, inefficient work of government as to environment protection, Braking norms of environmental protection by companies, Responsible behaviour
DFS	Depletion of Fish Stocks	Fishing in a considerable quantity, Reduction of quantity of fishes, Using of Sonar fishing system
RAW	Radio-active Waste	Dumping Radioactive waste
PPP	Polluter Pays Principle	Small fees for pollution for companies
LF	Luck of Financing	Economic crisis that led to the decrease of economic crisis that led to the decrease of production volume, lack of financing for cleaning facilities modernization, lack of financing on research and reasons of sulphide increase in the sea, lack of state programs of sea recover.
MP	Microbiological Pollution	Increase of harmful bacteria, harmful plants, Increasing of the plants in the sea
HA	Human activity	human activities
Sphi	Sulphide Increase	Increase of Sulphides
IA	Industrial Activities or Industrial Pollution	Industrial accidents, The rubbish of the enterprises, Content in water of considerable quantity of harmful substances, waste and dust, Coal cone-shaped dump on seacoast, Use of the out-of-date equipment at the enterprises, obsolete facilities in ports and at companies of the city.
S	S= Urban Sewage	Installing cleaning equipment, Sewage dumps into the sea, Installation of the water-purifying equipment, Breaking work of sewerage system, Costal pollution by restaurants and cafes without proper sewage facilities, opening restaurants and cafes without special facilities for sewage at the coast, Breaking work of sewerage system, (Air pollution)
ISP	Invasive species	Increasing of quantity of jellyfishes and other harmful animals and plant, Import of species into the black sea form other area
MSW	Municipal solid waste pollution to the sea	Pollution by household garbage, dust, city garbage dumps, Dirty equatorial of the sea-plastic packages and bottles, pollution sea by waste
MR	MR= Marine Research	Holding conferences concerning ecological protection seaside, constructing conferences on ecology.
RP	Riverine Pollutants	Pollution by river waters (heavy metals, fertilizers), Sea pollution with fiels waters, Pollution from large rivers like Danube and Dnepr, fertilizers, agricultural run-offs
SLR	Sea level rise	Increase in the sea level and average temperature of the sea
BW	Ballast Waters (ship dumps)	Ship dumps
Si	Siltation	Siltation of sea floor
M	Mining	Minerals extraction, Coal cone-shaped dump on seacoast
HAB	HAB (Harmful Algae Blooms)	Algae increase, Water Blossoming, algae growth, water bloom, Bloom of seaweed, Works of the grain husbandry on seacoast
ECOL	Ecological State of the marine environment	Pollution of the sea, Sickness of the sea, ecological situation of the sea, gulfs.

Concepts	Times mentioned
CD-Coastal Development	21
AOSP	18
DFS	18
Biodiversity	17
MSW	17
ISP	16
TOURISM	15
IA	14
S-Urban Sewage	12
HAB	10
D-Distrust to State & Institutions	7
MC-Microbiological Pollution	8
HA	7
ECOL	5
Lack of Financing	5
RP	4
CW	4

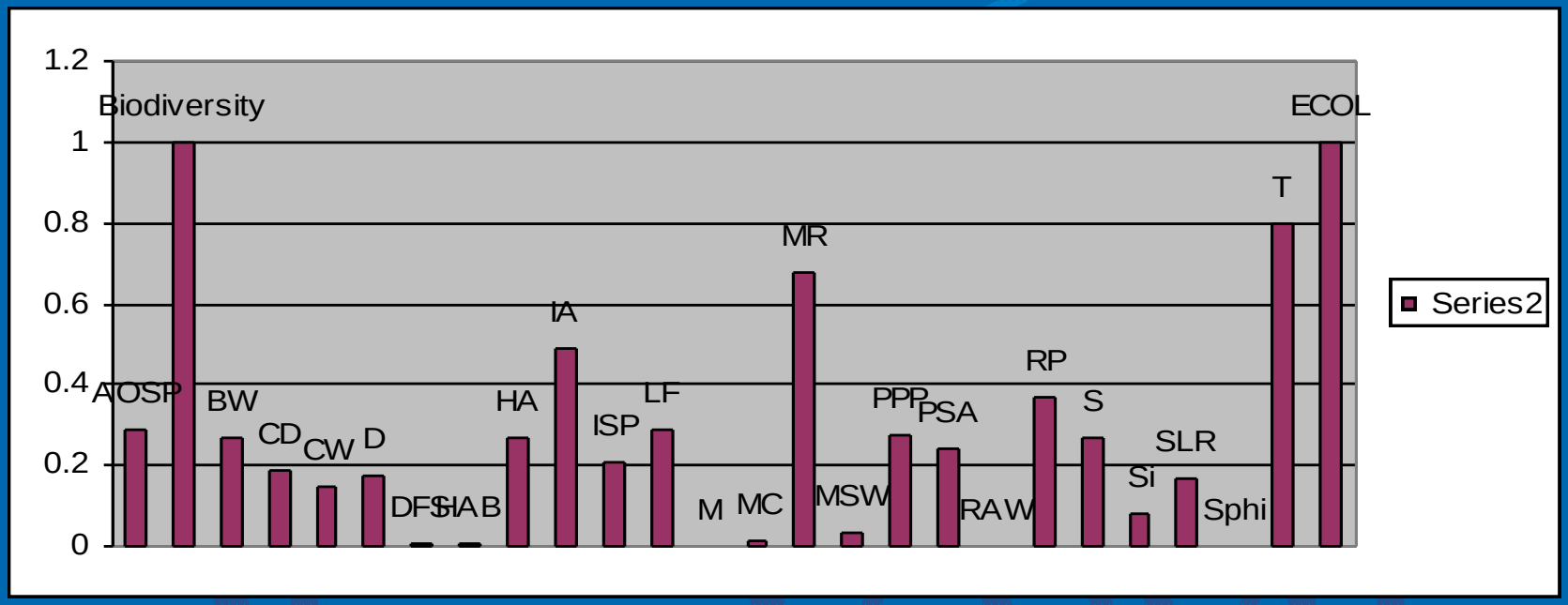
POLICY SCENARIOS

A number of scenarios were run using the FCM inference process to enable us to understand

- the complex cognitive structure of stakeholders about SES
- the perceived risks affecting SES marine ecosystems

and simulate (cognitive) impacts of alternative policy scenarios for environmental management.

POLICY SCENARIOS



Zero scenario: de-activating all concepts reveals an increase in Bd and ECOL, Tourism and Marine Research, indicating coexistence of all these concepts

Conclusions

- The results show that the use of FCMs is a reliable and efficient methodological tool for depicting lay people perceptions on environmental risks
- We have produced condensed FCMs for the studied countries showing high complexity
- By simulating alternative policy scenarios through collective FCMs, decision making can be early informed on cognitive impacts of planned environmental policies

Thank you for listening

Are you interested in drawing your own expert cognitive map???

Let us know!

POLICY RELEVANCE

- Is it really necessary our research to prove PR?
- What it has to do with science?
- How is this successful? (the track from science to policy making) bottom-up and top down approaches
- Stakeholder analysis: Why is it useful? Link with the previous
- The problem: Linguistic and cultural differences. By translating three times the stakeholders' concepts we loose information and enlarge uncertainty within the scientific depiction (translation εκμαίευση? Αποτύπωση?,ερμηνεία?) of stakeholders concepts

Which Research Methodologies for SA?

- **Qualitative** research concentrates on words and observation to express reality and attempts to describe people in natural situations.
- **Quantitative** approaches place considerable trust in numbers that represent opinions or concepts
- Qualitative research will provide in-depth information into fewer cases whereas quantitative procedures will allow for more breadth of information across a large number of cases
- **Combining** qualitative and quantitative procedures results in greater methodological mixes that strengthen the research design

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Eastern Mediterranean Sea: The problem

A variety of anthropogenic pressures

(urbanization, sewage & urban run-off, solid waste, marine transport, eutrophication, alien species, etc.)

Ecosystem resilience

Biodiversity conservation

Eastern Mediterranean Sea: The problem

Main factors for biodiversity loss

Destruction of critical marine habitats

&

Invasive alien species

Goods and services provided by marine ecosystem & biodiversity

- Food provision
- Raw materials
- Leisure & recreation
- Economic benefits from tourism
- Economic benefits from fisheries
- Climate regulation
- Water purification
- Natural hazard regulation
- Scientific knowledge
- Future unknown benefits

Beaumont et al. (2007), "Identification, definition and quantification of goods and services provided by marine biodiversity: Implications for the ecosystem approach", *Marine Pollution Bulletin* **54**, 253-265.

Objectives of the case study

- Exploration of perceptions & preferences of Thessaloniki's (Greece) citizens concerning marine environment's resilience, biodiversity and the associated goods & services
- Elicitation of the values that individuals attach on the main factors that support native biodiversity

The method

- A Choice Experiment (Stated Preference technique) was designed and implemented
- Choice Experiment's attributes:
  - Cover area of important marine biotopes
  - Abundance of alien species
  - One-time payment
- Specific ecosystem services were associated with each of the two first attributes

The method

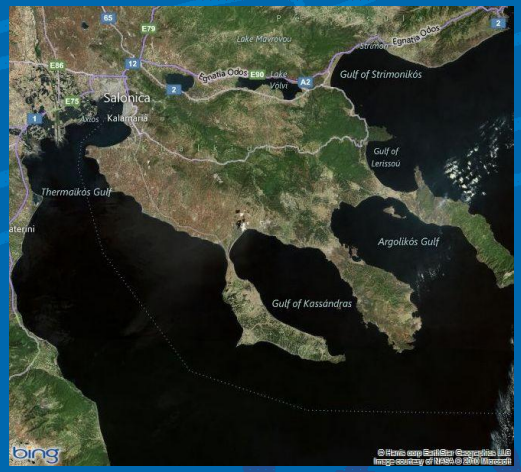
- Each choice set had two alternatives
  - Status quo option with no financial cost
  - An alternative improved situation with a specific financial cost
- Fixed parameter logit model including interactions between attributes and socio-demographic characteristics

Example of a choice set

	Option A:	Option B:
Cover area of important marine biotopes:	 **20% LESS cover area than the current** (From every 100m², 20m² will be lost) **NEGATIVE impacts in:** Climate regulation - Mitigation of climate change - Water purification	 **20% MORE cover area than the current** (To every 100m², 20m² will be added) **POSITIVE impacts in:** Climate regulation - Mitigation of climate change - Water purification
Populations of alien marine species:	 **LARGE populations of alien species** (more than native species) **NEGATIVE impacts in:** Tourism – Public health - Fisheries	 **SMALL populations of alien species** (less than 10% of native species) **POSITIVE impacts in:** Tourism – Public health - Fisheries
Cost (one payment)	0 €	60 €

Survey

- Survey took place in Thessaloniki, Greece



- 300 valid questionnaires were completed by face-to-face interviews
- Representative sample of Thessaloniki's population

Results

- Most significant problems of marine ecosystem as perceived by respondents
  - Industrial sewage (45%)
  - Urban sewage (19.7%)
  - Oil spills & pollution from ships (17.3%)
  - Pesticides & fertilizers (7%)
  - Rubbish at coasts & sea (6%)
  - Coastal construction / urbanization (2.3%)
  - Overfishing (2.3%)

Results

- Knowledge and importance of ecosystem services:

Ecosystem services:	High importance rating:	Don't know service or/and cannot evaluate importance:
Food provision	81%	0%
Raw materials	20.7%	1%
Leisure & recreation	66.7%	0.7%
Economic benefits from fisheries/aquaculture	60%	2%
Economic benefits from tourism	81.7%	0%
Climate regulation	52.3%	35.3%
Water purification	40.7%	26%
Dampening of extreme weather events	25%	50.3%
Scientific knowledge	39.7%	20%
Future unknown benefits	22.3%	47.3%

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Climate regulation	52.3%	**35.3%** (27.3 + 8)
Water purification	40.7%	**26%** (18.7 + 7.3)
Dampening of extreme weather events	25%	**50.3%** (41.3 + 9)
Scientific knowledge	39.7%	**20%** (1 + 19)
Future unknown benefits	22.3%	**47.3%** (1 +46.3)

Results

- Trust in institutions:

Trust in:	Mean	Std. deviation
Local universities	6,69	2,381
NGOs	6,22	2,736
UNEP/MAP	6,13	2,575
International organizations	5,69	2,474
Greek private companies	3,48	2,776
Local municipalities	3,2	2,673
Ministry of Environment	3,1	2,619

Results

- Model coefficients estimations:

	Value	Std. Error	t-value
ASC	-4.55357419760***	0.80427610237	-5.661705
BIOTOPES	3.92759733193	2.43430242435	1.613439
ALIEN	6.80764363272***	1.36626888719	4.982653
COST	-0.03716517088***	0.01275436731	-2.913917
BIOTOPES*ALIEN	-5.93934609936***	0.83150029710	-7.142927
BIOTOPES*EDUYEARS	0.97692288567*	0.52261281585	1.869305
BIOTOPES*AGE2	-0.00019866098*	0.00011817230	-1.681113
BIOTOPES*EDUYEARS2	-0.07025037448*	0.03874368111	-1.813209
BIOTOPES*EDUYEARS3	0.00162908439*	0.00091313284	1.784061
ALIEN*AGE	0.09823042016**	0.04523979486	2.171328
ALIEN*AGE2	-0.00130536724***	0.00046088807	-2.832287
ALIEN*MAR1	-0.71950703529**	0.32681791201	-2.201553
ALIEN*MAR2	-0.72699777372*	0.43210347371	-1.682462
ALIEN*RES	0.31713748034*	0.18229038547	1.739738
COST*INCOME	-0.01485563298**	0.00750747665	-1.978778
COST*INCOME2	0.00270568636*	0.00149504821	1.809765
COST*INCOME3	-0.00013115464	0.00008949589	-1.465482
COST*AGE2	0.00000534471**	0.00000210997	2.533074
COST*MAR2	0.00958108941**	0.00394948878	2.425906

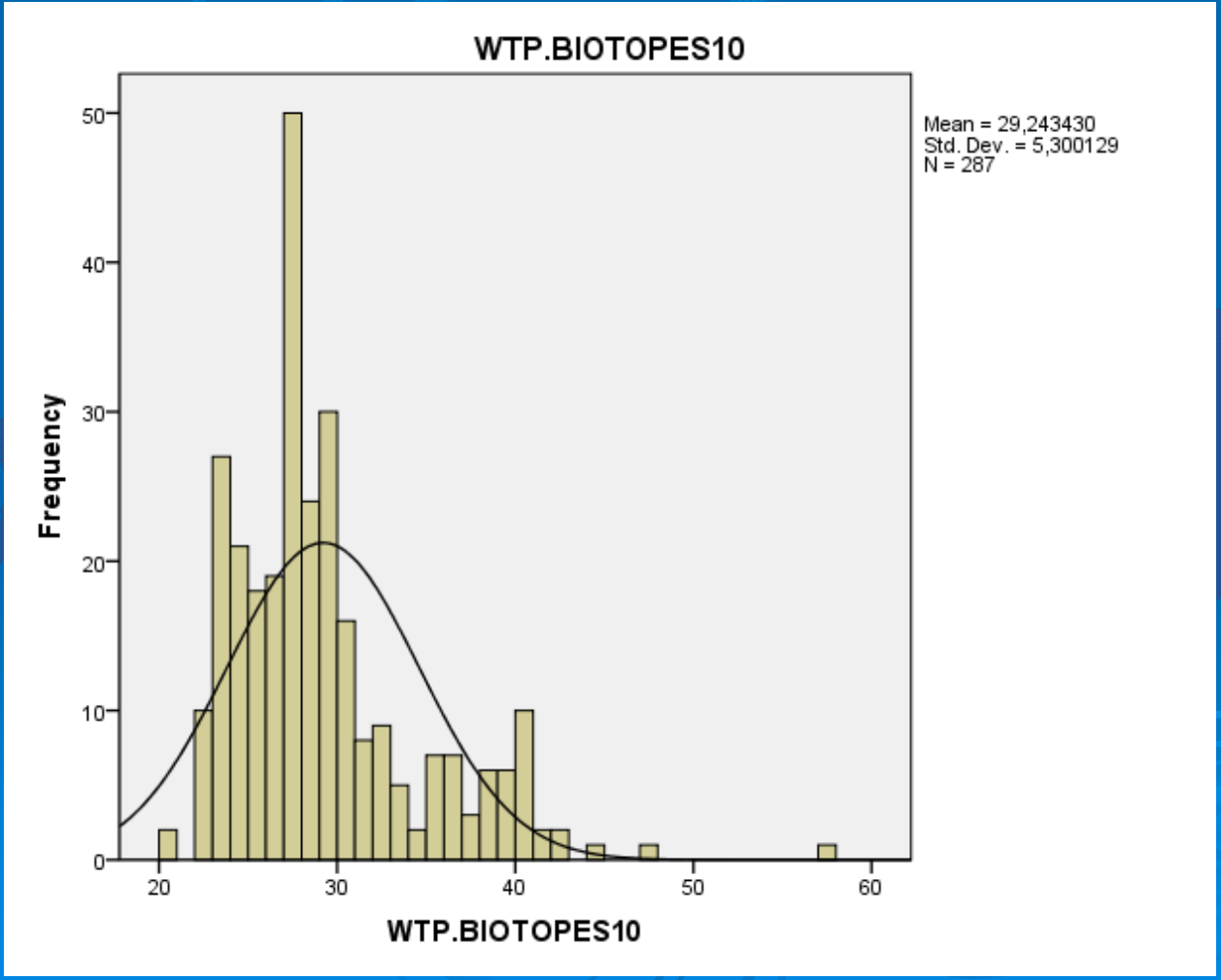
Results

- Model fit statistics:

	Values
Log-likelihood function	-699.1774
Akaike information criterion (AIC)	1440.355
Bayesian information criterion (BIC)	1560.872
McFadden's R^2	0.5606709

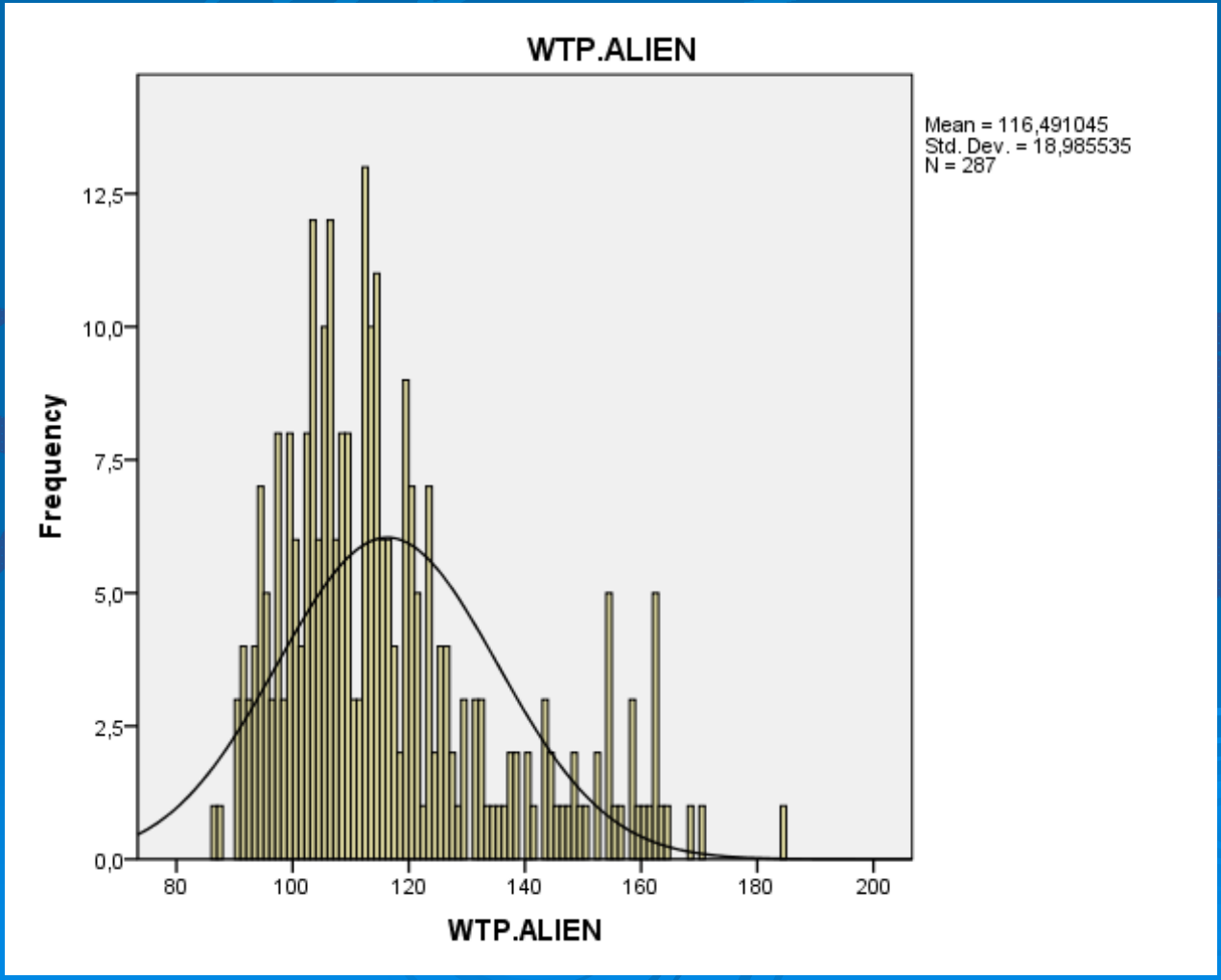
Results

- Distribution of respondents' WTPs for BIOTOPES attribute:



Results

- Distribution of respondents' WTPs for ALIENS attribute:



Results

- Mean WTP (one-time payment):
  - 29.24€ for a 10% extra cover area of important marine biotopes
  - 116.49€ for a transition from large populations to small populations of alien species

Conclusions

- Thessaloniki's citizens are willing to pay a one-time payment of 29.24€ for preserving a 10% extra cover of critical marine biotopes and 116.49€ for decreasing alien species abundance and moving from large to small populations.
- Since respondents were not found to be particular familiar with alien species and with ecosystem services offered by critical biotopes, we believe that if more work is done in the field of raising awareness regarding the impacts of alien species and the benefits from key marine ecosystem regulating services, the value attached to the attributes will increase.
- For the immediate future we plan to make a deeper analysis on the data set in order to understand more rigorously the underlying interactions between the attributes and to further reveal the role of socio-demographic characteristics in the choices made.

Thank you!