

Ecological and socioeconomic valuation of marine biodiversity in the Gulf of Gdańsk

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UNIwersYTET GDAŃSKI



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NoE MarBEF – Marine Biodiversity and Ecosystem Functioning

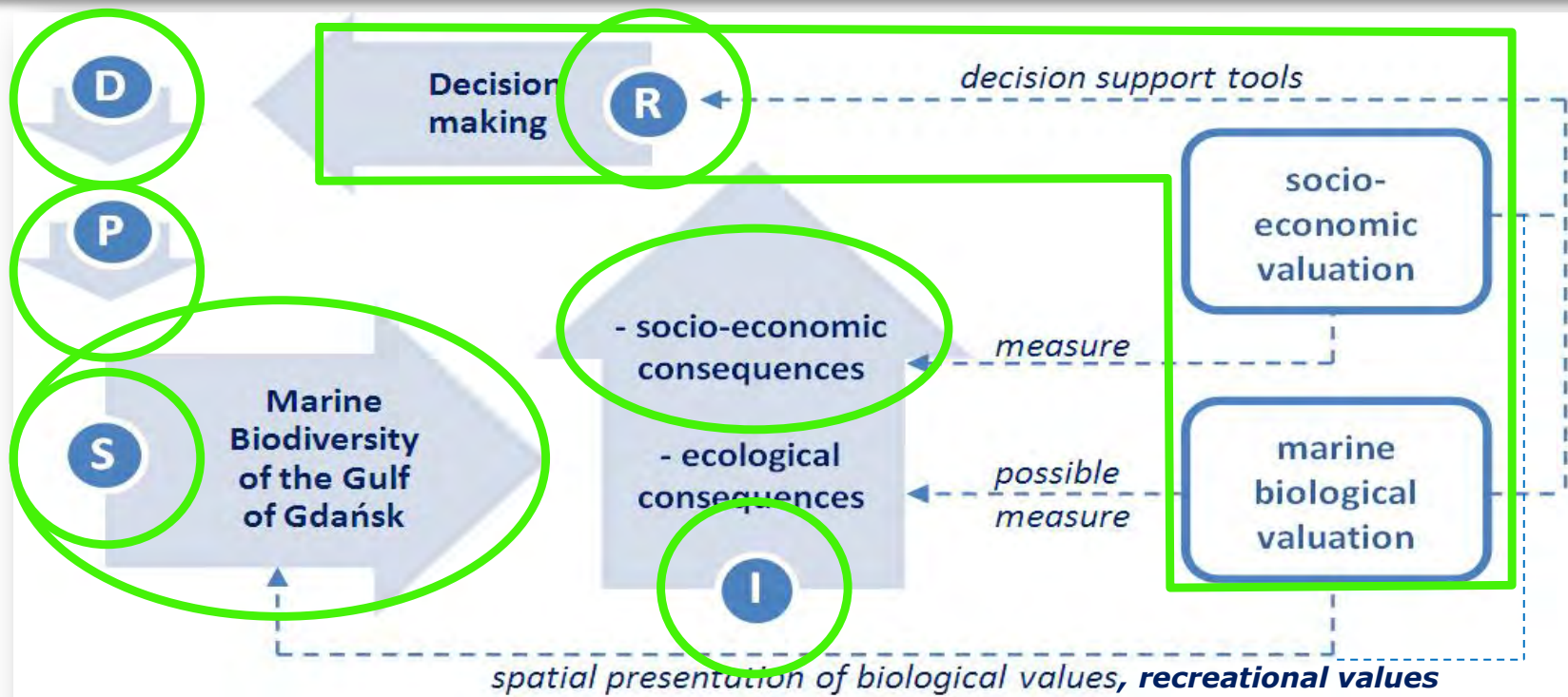
Ecological
valuation

Socioeconomic valuation

Contingent
valuation
(CVM)

Assessment
and spatial
visualization
of recreational
values

The research actions were planned to support, with the scientific information, the interrelations that occur in the DPSIR model



In order to structure as well as to provide the information on **the State** of marine biodiversity of the Gulf of Gdańsk, **marine biological valuation** concept and protocol were employed. Also the **revealed preferences economical valuation** was applied (recreational values).

In order to assess the socio-economic **Impact** of marine biodiversity loss, the **socio-economic valuation method** (Contingent Valuation) was performed.

Application of all valuation approaches seem to improve **the Responses** of the society.

The Responses may lead to a better management of some **Driving Forces** or **Pressures** (prevention, mitigation), to maintain or restore **the State** of the environment, or to help to accommodate to **Impacts** (adaptation).

– ecological valuation – aims

- development of **biological valuation maps**:

- (i) separate ones representing the **integrated biological value** for each biodiversity component
- (ii) integrated one incorporating the **total biological valuation** results
- (iii) **reliability layer** for the estimated total marine biological valuation map

– ecological valuation – method

VALUATION CRITERIA

RARITY

- PRESENCE OF RARE SPECIES
- ABUNDANCE OF RARE SPECIES
- ABUNDANCE OF HABITAT-FORMING SPECIES
- ABUNDANCE OF ECOLOGICALLY-IMPORTANT SPECIES

AGGREGATION / FITNESS CONSEQUENCES

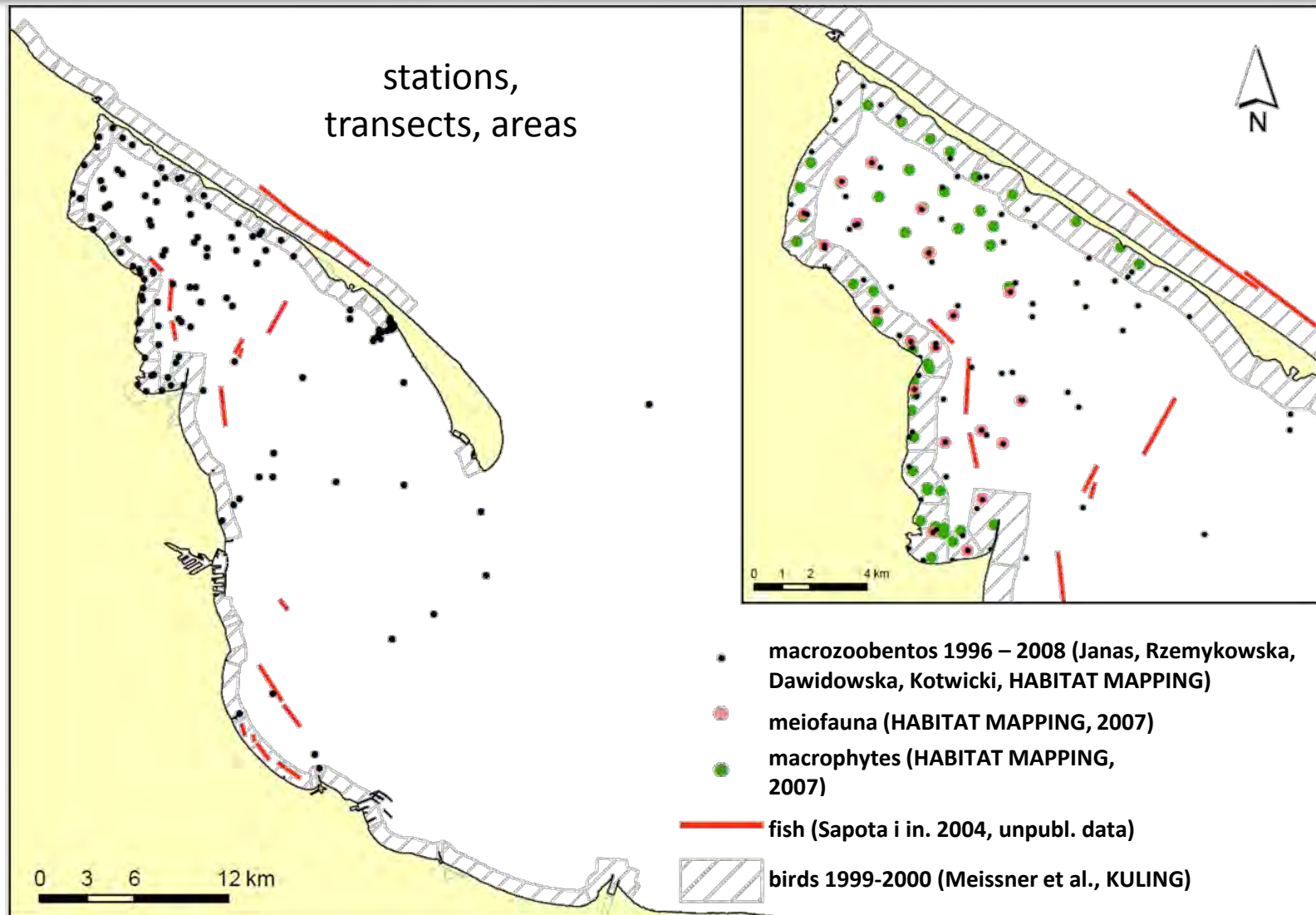
- ABUNDANCE OF SPECIES
- AGGREGATION OF CERTAIN SPECIES
- TAXONOMIC DIVERSITY
- BIOMASS

MARINE BIODIVERSITY COMPONENTS

**MACROALGAE / VASCULAR PLANTS / MEIOFAUNA /
MACROZOOBENTHOS / FISH / BIRDS**



– ecological valuation – method



– ecological valuation – method

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MARINE BIODIVERSITY COMPONENTS

**MACROALGAE / VASCULAR PLANTS / MEIOFAUNA /
MACROZOOBENTHOS / FISH / BIRDS**

1
VERY LOW

2
LOW

3
MEDIUM

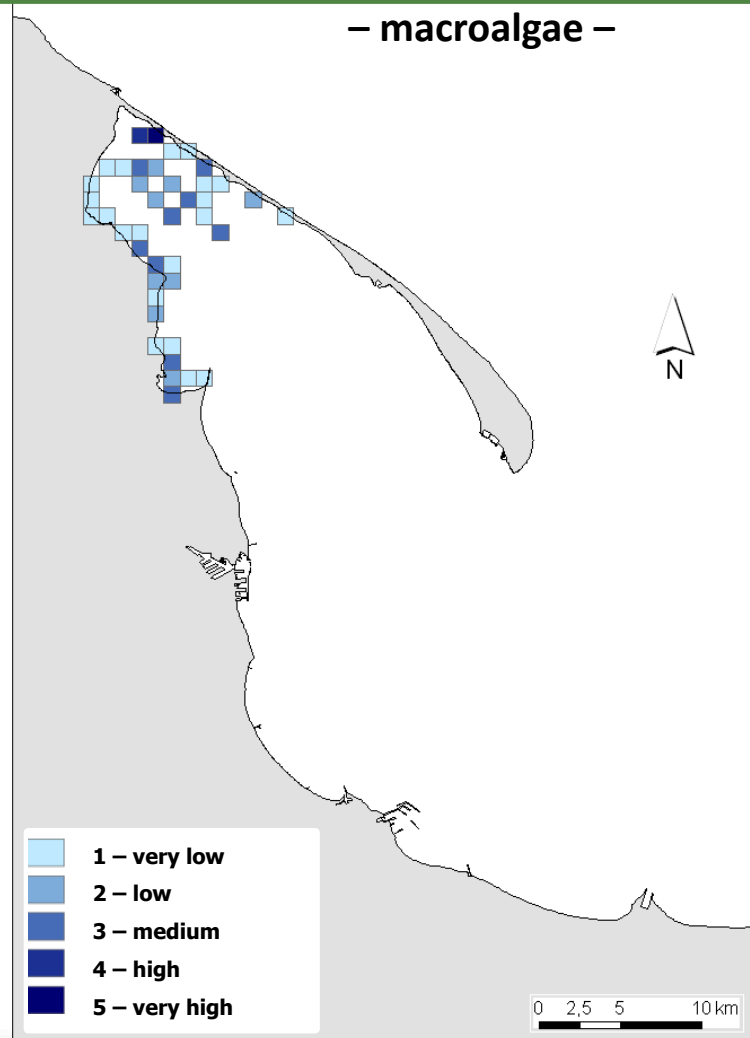
4
HIGH

5
VERY HIGH

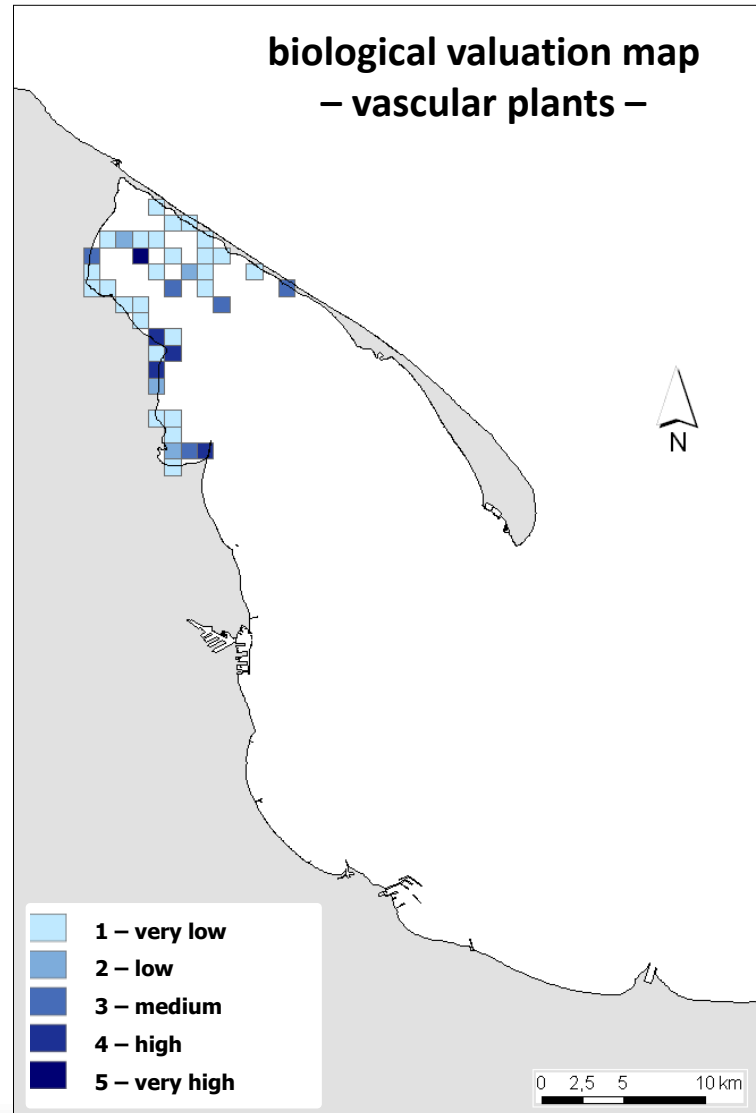
– ecological valuation – results

BIOLOGICAL VALUATION MAPS

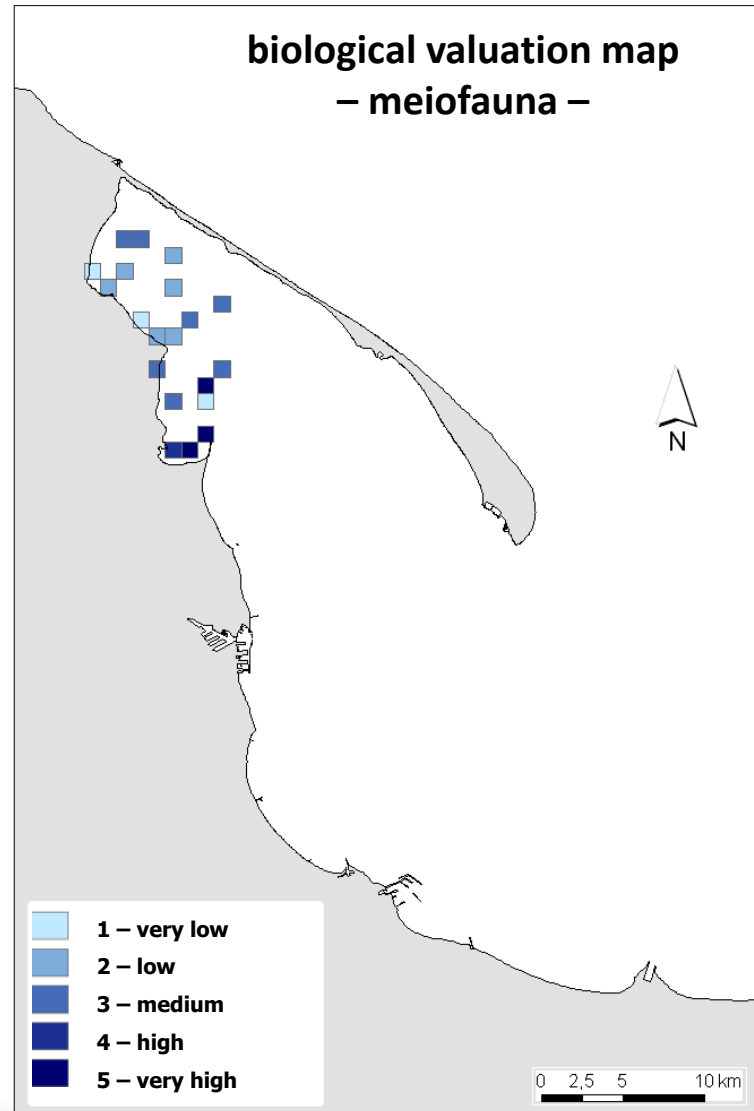
– macroalgae –



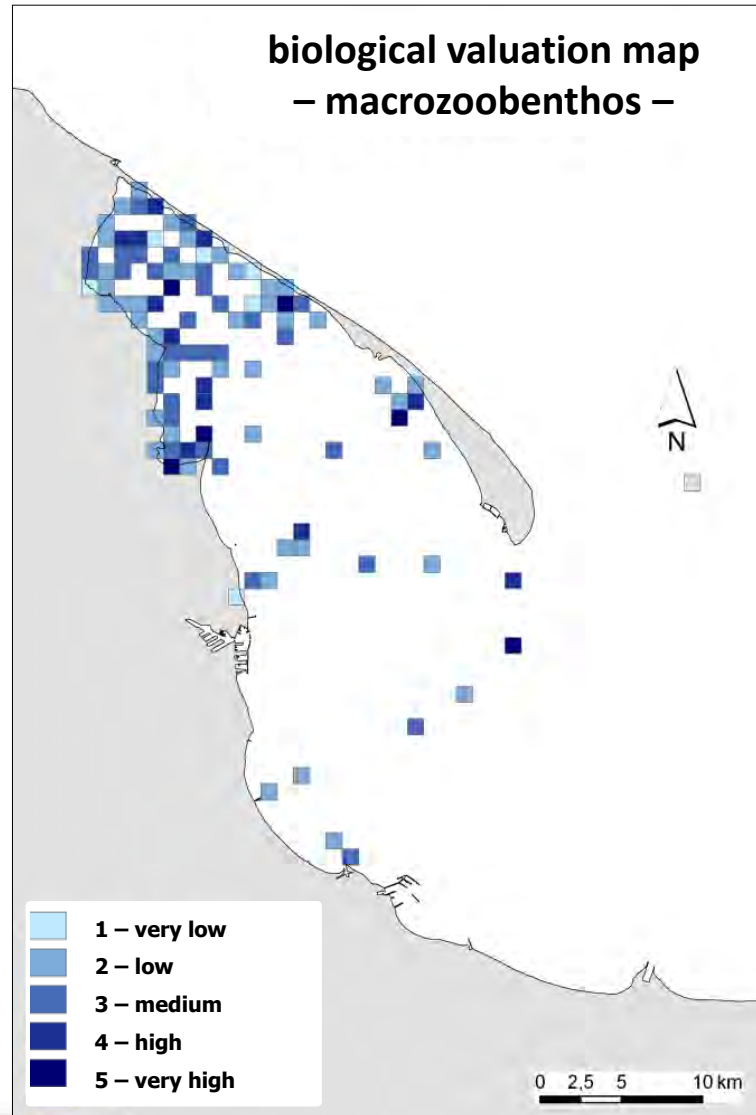
– ecological valuation – results



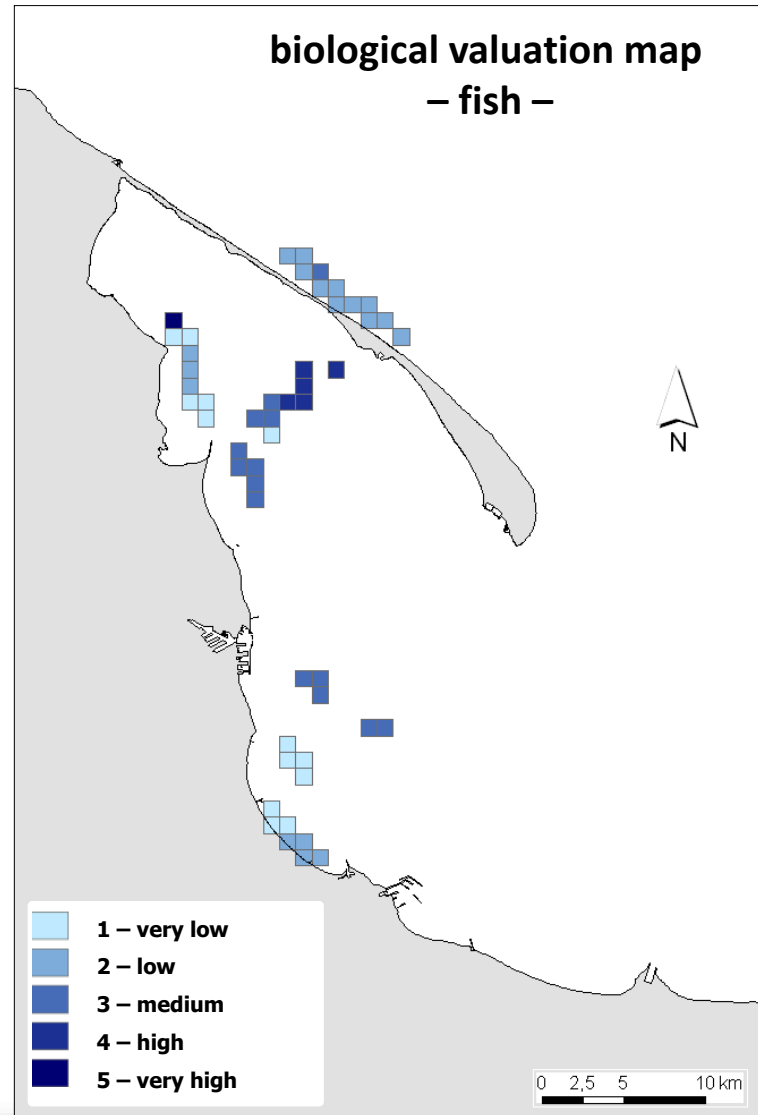
– ecological valuation – results



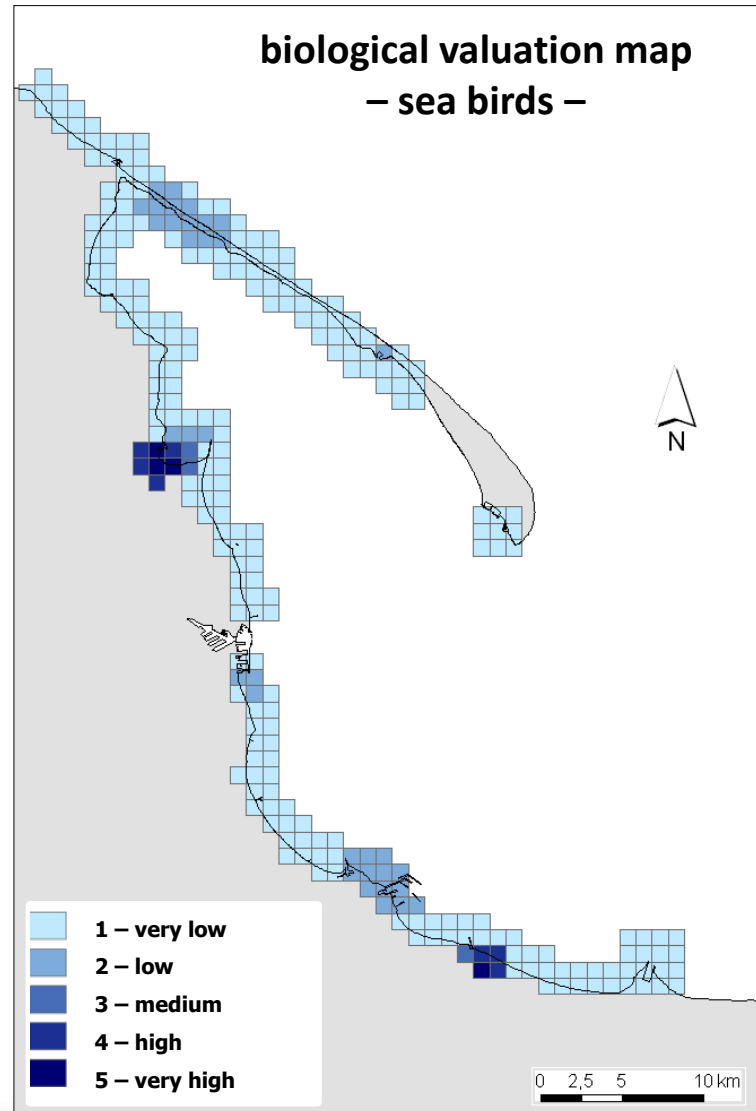
– ecological valuation – results



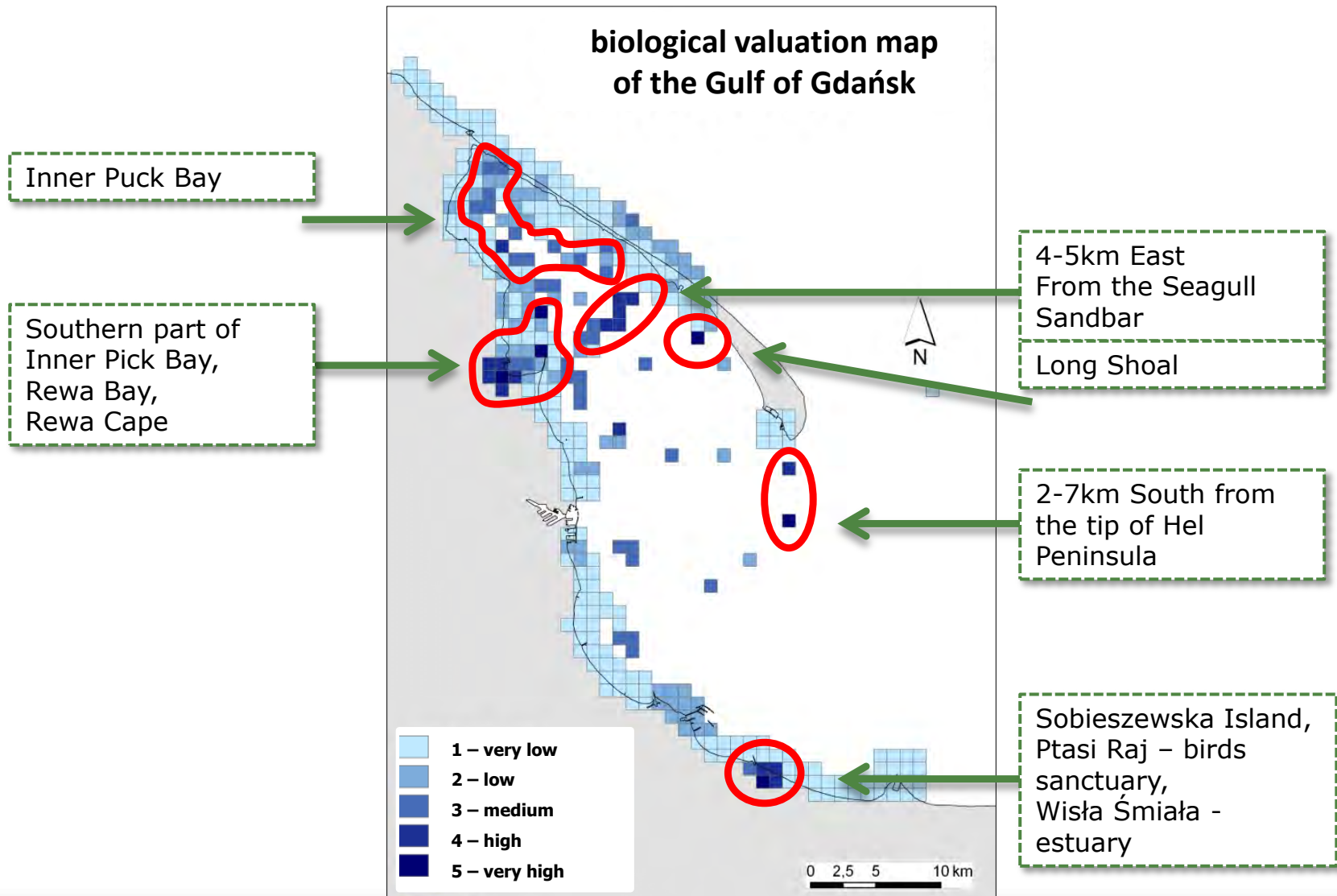
– ecological valuation – results



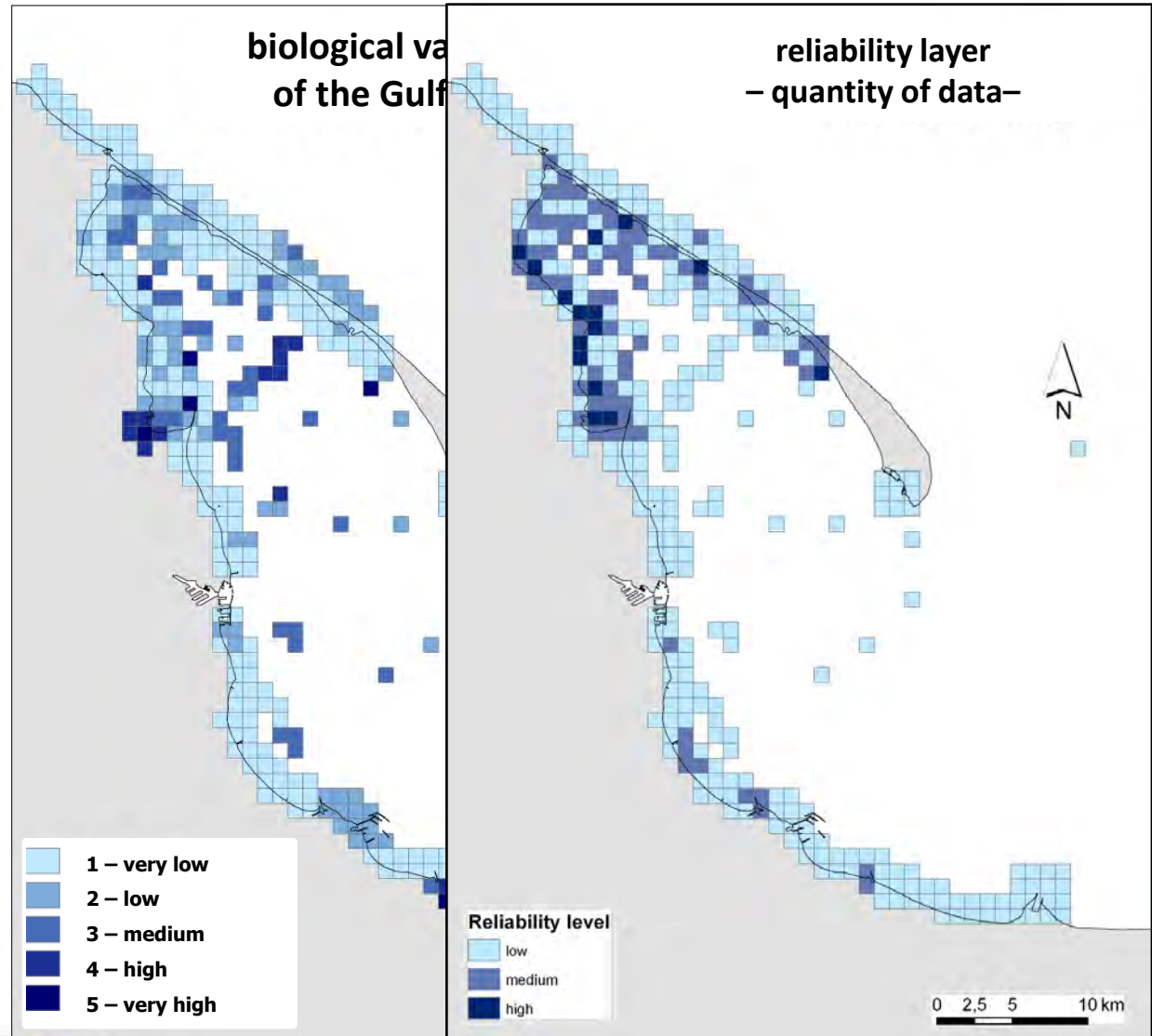
– ecological valuation – results



– ecological valuation – results



– ecological valuation – results



– ecological valuation – conclusions/recommendations

The **concept of biological valuation** and the assessment questions **include most of the levels of marine biodiversity** (structures and processes/functions) and the assessment questions assuring equal treatment of the biocenosis components analyzed. Therefore, the produced spatial projections reflect an **integrated view** upon the **biological values** of the study area.

Maps should be used as **baseline maps** for any plans that allocate different user functions of marine areas.

Maps can support the **indication of conflicts** between human uses and a valuable area. Therefore, they can be considered as a **warning system** for marine planners and managers, while directing and organizing human activities at sea.

The **biological valuation framework**, after the extension of the criteria set by the 'representativeness', 'integrity', 'socio-economic importance' **could be used as a support tool for designation of new marine protected areas**.

The **biological valuation framework** can support **spatial visualisation** of various scenarios of **environmental changes** (different levels of decrease or increase of abundance of certain species, extinctions of rare or vulnerable species, changes in biomass, etc.). Potential use - **Environmental Impact Assessment (EIA)** as well as the Strategic EIA during obligatory considerations of alternative scenarios.

– socioeconomic valuation (CVM) – aims

- examine what are the **human preferences** towards conservation of different marine taxa,
- identify **differences in economic valuation** of marine biodiversity of the Gulf of Gdańsk **among different society sectors**
- determine **variability in economic values** of **different levels of loss** in marine biodiversity of the Gulf of Gdańsk,

– socioeconomic valuation (CVM) – method

CONTINGENT VALUATION METHOD – CVM

- CVM – The Contingent Valuation Method is the **most commonly** used **non-market valuation technique** for the assessment of the economic value of environmental goods .
- **non-marketed goods** is introduced on **hypothetical markets** – respondent *buyer* – ‘pays’ for certain good (change in good provision)

WILLINGNESS TO PAY (WTP) TO AVOID A DECREASE IN MARINE BIODIVERSITY IN THE GULF OF GDANSK...

– socioeconomic valuation (CVM) – method

TARGET POPULATION AND SAMPLING TECHNIQUE



Two separate Contingent Valuation surveys were performed.

**August – October
2007 i 2008**

2007

268 residents

244 visitors

2008

376 residents

125 visitors

512

respondents

501

respondents

– socioeconomic valuation (CVM) – method

VALUATION SCENARIOS

2007

10% and 25% loss in the no of species ...

... within each taxa macroalgae,
invertebrates, fish,
sea birds, sea mammals

2008

10%,25%, 50% loss in the no of species ...

... within
fish

Number of species of each taxa was considered as a **proxy** to introduce the **marine biodiversity concept** to the respondents

„What would be the maximum amount you would be willing to pay as a one only payment to a neutral trust fund, in order to avoid decline of number of invertebrate species by 10% in the Gulf o Gdańsk, meaning disappearance of 9 species?“.

– socioeconomic valuation (CVM) – method

WILLINGNESS TO PAY $WTP = f(1,2,3)$

1 – valuation scenario (marine taxa and level of decrease)

2 – marine biodiversity attitudinal variables,

3 – socio-demographic features

A **maximum likelihood interval regression** approach was used.

A bid curve for preservation of marine biodiversity was estimated by using **WTP as the dependent variable** and the set of independent variables.

The purpose of bid equation was to find out **what the most significant variables that influence the WTP were.**

– socioeconomic valuation (CVM) – results

ACCEPTANCE OF VALUATION SCENARIO

CVM	Total sample	WTP > 0		WTP = 0		protest notes			final sample
		<i>no of pers.</i>	<i>% of total</i>	<i>no of pers.</i>	<i>% of total</i>	<i>no of pers.</i>	<i>% WTP neg.</i>	<i>% of total</i>	
2007	512	253	49,4%	259	50,6%	161	62,2%	31,4%	351
2008	501	280	55,9%	221	44,1%	81	36,7%	16,2%	420

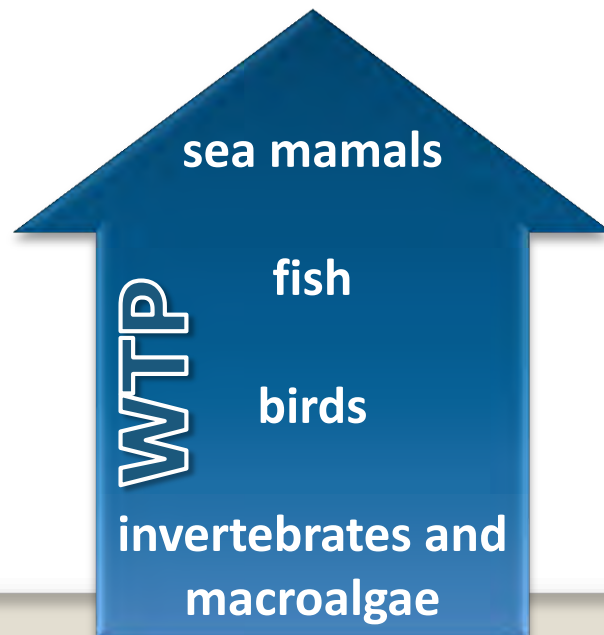
the **protest responses excluded** from further analysis

positive and true/genuine zero responses – integrated in the dependent variable

– socioeconomic valuation (CVM) – results

ECONOMETRIC MODEL – CVM 2007

Independent variables	coefficient	St. Dev.	Z	p	Sig.
(Intercept)	-4,909537	0,555	-8,84	p<0,01	***
Scenario: sea mammals	1,153381	0,103	11,16	p<0,01	***
Scenario: fish	0,778972	0,080	9,67	p<0,01	***
Scenario: birds	0,506905	0,081	6,25	p<0,01	***
Scenario: invertebrates	0,051524	0,083	0,62	0,5340	n.s.



– socioeconomic valuation (CVM) – results

Declared WTP values in order to avoid decline of number of species by **10%** or **25%**
CVM survey – year **2007**.

sea mammals (*25% scenario only*)

residents	16 EUR
visitors	15 EUR

fish

residents	11 – 13 EUR
visitors	10 EUR

birds

residents	8 – 10 EUR
visitors	7 – 8 EUR

macroalgae and invertebrates

residents	5 – 6 EUR
visitors	4 – 5 EUR

– socioeconomic valuation (CVM) – results

ECONOMETRIC MODEL – CVM SURVEY 2007

Independent variables	coefficient	St. Dev.	Z	p	Sig.
resident/visitor(1.0)	0.420157	0.062	6.79	p<0.01	***
Log income	0,870150	0,057	15,24	p<0,01	***
Age – linear form	0,025431	0,018	1,43	0,154	n.s.
Age – quadr. form	-0,000321	0,000	-1,43	0,153	n.s.
Education – linear form	0,217242	0,283	0,77	0,443	n.s.
Education – quadr. form	-0.029746	0.048	-0.62	0.534	n.s.
MB Cons.– important, no priority	-0,321852	0,061	-5,30	p<0,01	***
MB Cons. – not important	-2,813214	0,000	-Inf	p<0,01	***
MB Cons. – neutral	-1,561766	0,322	-4,85	p<0,01	***
conservation NGO (1,0)	0,513782	0,142	3,61	p<0,01	***

- **Residents** declare **higher WTP bids** than **visitors**
- **Monthly income** – one of the most relevant factor influencing **WTP**
 - **Age and education** – no influence on **WTP**
- **attitudes** towards marine biodiversity conservation – **higher priority** → **higher WTP**
 - **membership in conservation NGO** → **higher WTP**

– socioeconomic valuation (CVM) – results

Declared WTP values in order to avoid decline of number of fish species by **10%, 25% and 50% from the *status quo***. CVM survey – year **2008**.

FISH – species loss

10%

residents
visitors

42 EUR
45 EUR

25%

residents
visitors

51 EUR
55 EUR

50%

residents
visitors

64 EUR
57 EUR

– socioeconomic valuation (CVM) – conclusions

- **VISITORS AND RESIDENTS OF THE GULF OF GDAŃSK REGION ATTACH POSITIVE AND SIGNIFICANT VALUES TO THE LOCAL CONSERVATION OF MARINE SPECIES.**
- **THE RESPONDENTS DEFINE A CLEAR ORDER OF PUBLIC PREFERENCE FOR MARINE MAMMALS, FOLLOWED BY FISH, THEN BIRDS AND EVENTUALLY INVERTEBRATES AND ALGAE.**
- **DESPITE THE LOWEST WTP ESTIMATES FOR CONSERVATION OF INVERTEBRATES AND ALGAE AMONG OTHER ANALYSED TAXA, IT IS WORTH HIGHLIGHTING THAT THEIR VALUE WAS SIGNIFICANTLY GREATER THAN 'ZERO'. RESPONDENTS ARE AWARE THAT THE SEA ECOSYSTEM CONSISTS OF MORE THAN THE CHARISMATIC (VISIBLE) ANIMALS ONLY.**

– socioeconomic valuation (CVM) – recommendations

- THE WTP PROVIDE FUNDAMENTAL **GUIDELINES** ON THE **AMOUNT OF PUBLIC INVESTMENT** THAT COULD BE ALLOCATED TO AVOID THE LOSSES IN MARINE BIODIVERSITY. THE RESULTS CAN ALSO BE TREATED AS A **SCIENTIFIC JUSTIFICATION** OF THE ALREADY EXISTING **INCENTIVES** FOR THE **WOEFULLY UNDERFUNDED MARINE BIODIVERSITY CONSERVATION** (MEASURES).
- **WTP VALUES**, AFTER APPROPRIATE **AGGREGATION**, COULD BE USED FOR **COMPARISON** BETWEEN THE **CONSERVATION BENEFITS** AND **ALTERNATE USES/POLICIES** (OPPORTUNITY COSTS), SUCH AS COMMERCIAL FISHERIES, RECREATIONAL FISHING, PROJECTED ENVIRONMENTAL IMPACTS (E.G. HABITAT DESTRUCTION AND FRAGMENTATION, POLLUTION), ETC.
COST-BENEFIT ANALYSIS (CBA).



Different cultures, different values: The role of cultural variation in public's WTP for marine species conservation

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Towards an ecosystem approach for understanding public values concerning marine biodiversity loss

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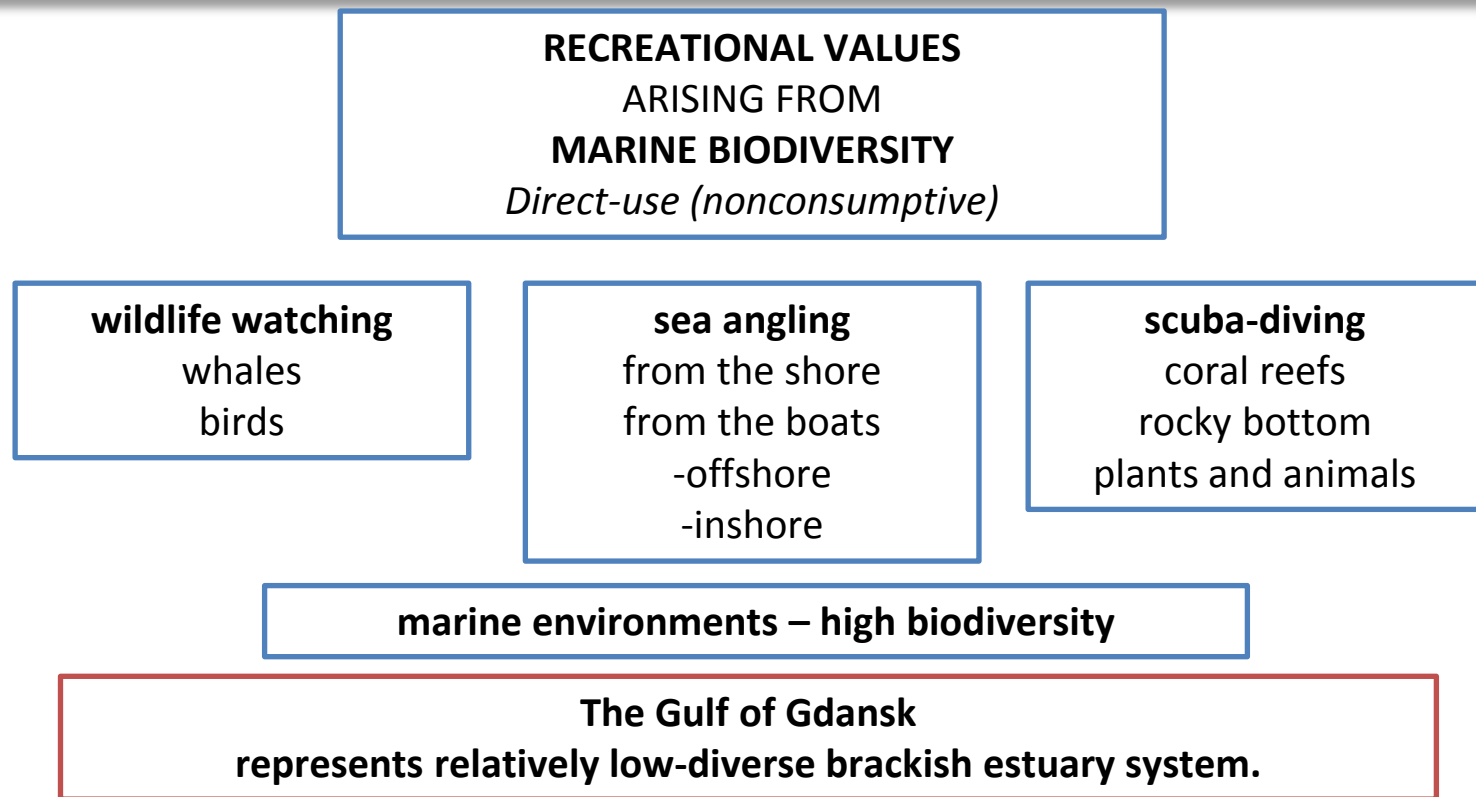
² Institute of Oceanography, University of Gdansk, Al. Marszałka Piłsudskiego 46, Gdynia Pomorskie 81-378, Poland

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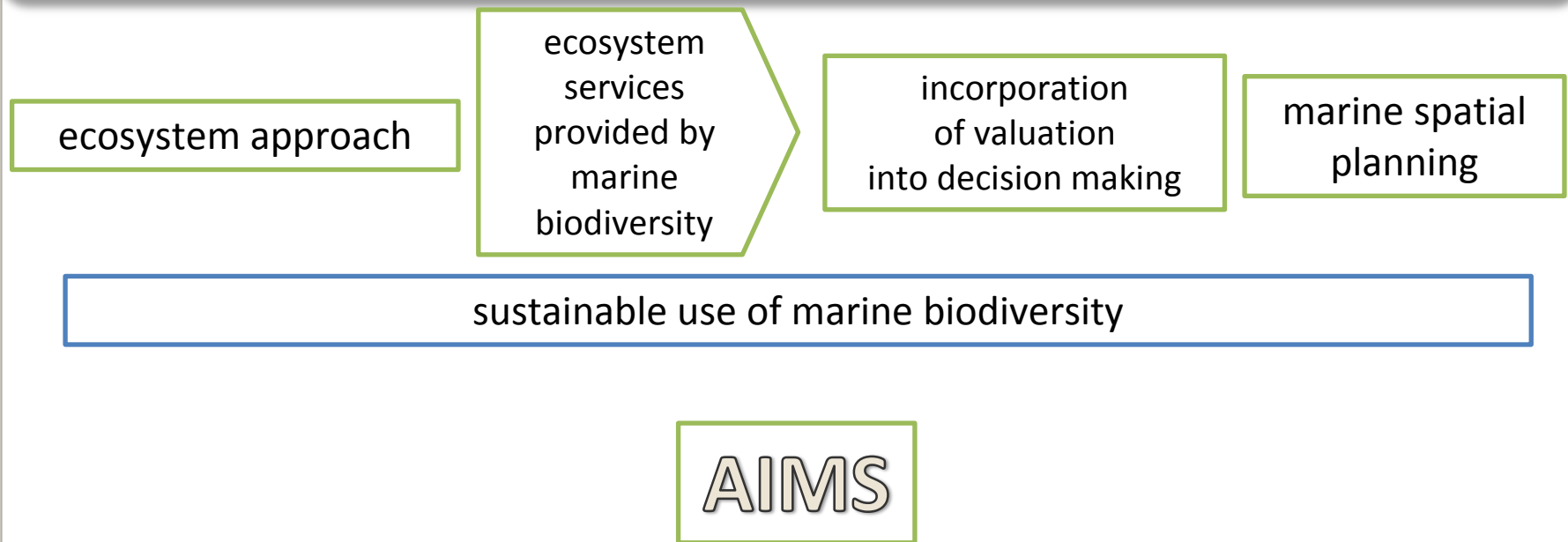
– socioeconomic valuation – recreational values - aims



In full marine environments where the salinity level, tides and overall ocean characteristics promote high biodiversity. Watching sea mammals or marine birds in their natural habitats is rather uncommon and is of accidental character.

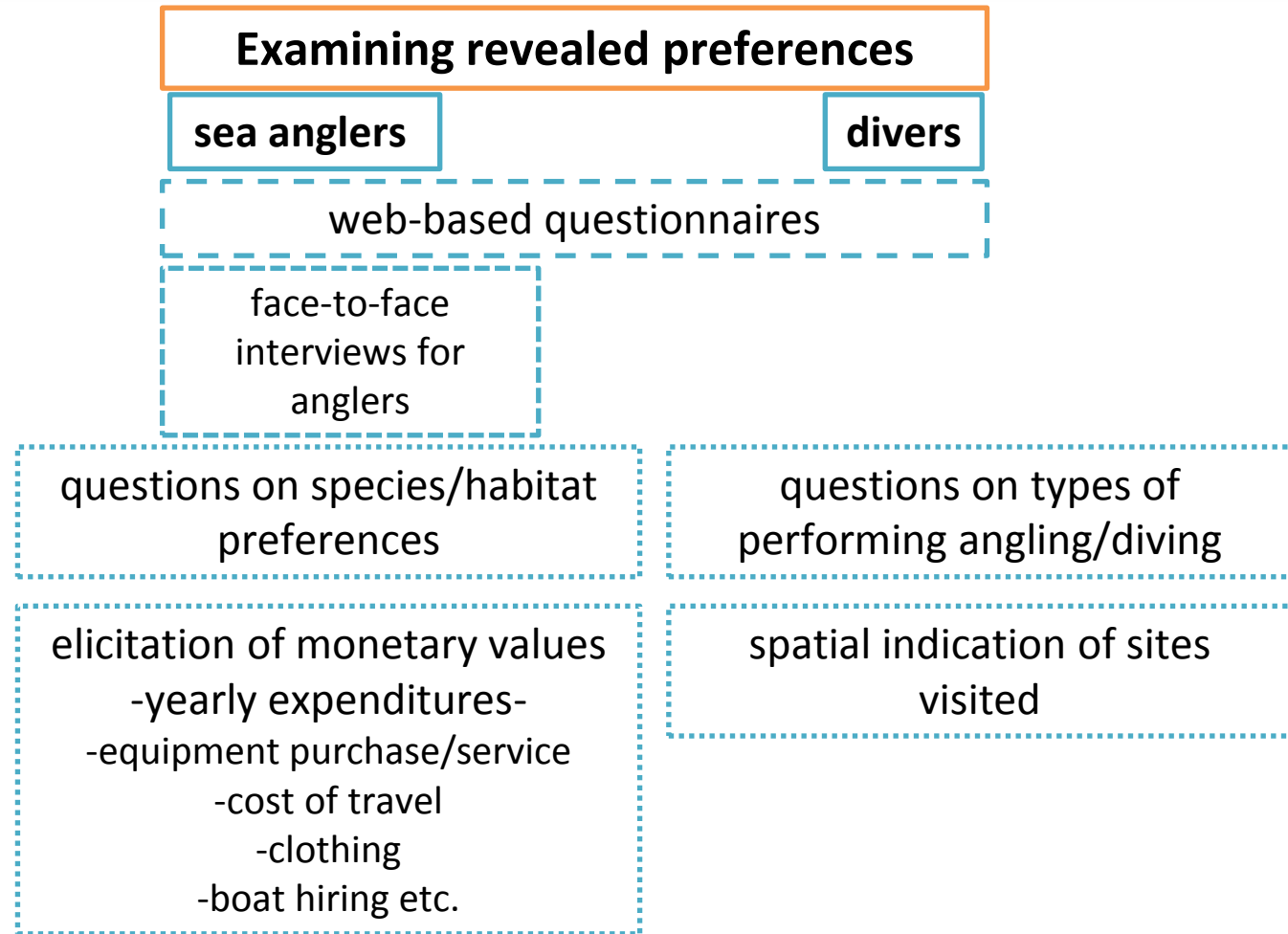
The only recreational options which involve the number of people sufficient to examine preferences regarding these activities are sea angling and scuba-diving.

– socioeconomic valuation – recreational values - aims



- **Assessment of the recreational value** of the Gulf of Gdańsk biodiversity, by analyzing revealed preferences of sea anglers and divers.
 - **Visualization of spatial distribution of recreational values** arising from marine biodiversity in order to indicate habitats and species that take part in the provision of the recreational service.

– socioeconomic valuation – recreational values - method



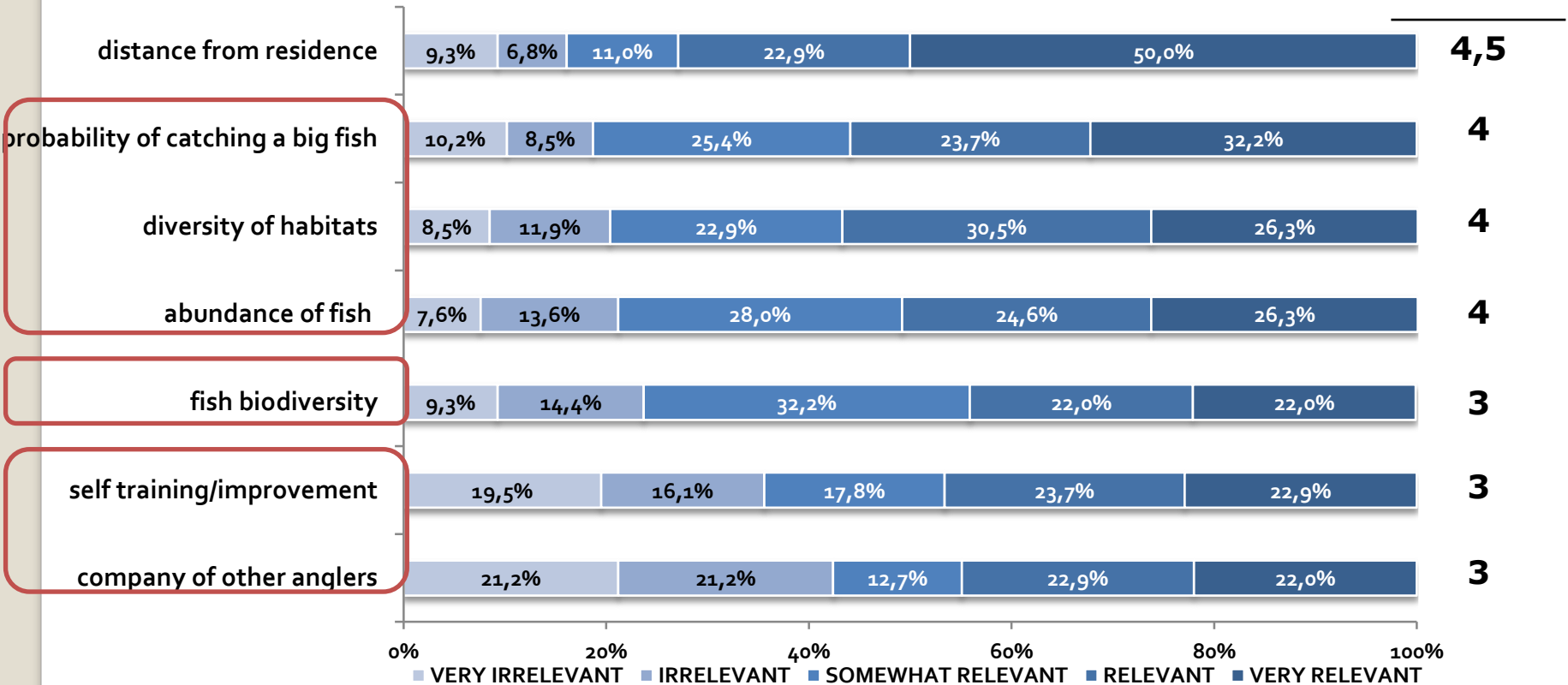
- sea anglers (**89** web-surveys and **29** face-to-face surveys completed)

- sea divers (**63** web-surveys completed)

– socioeconomic valuation – recreational values - results

Reasons for choosing the Gulf of Gdansk as an angling destination.

median



Preferences:

size of fish ~ diversity of habitats ~ abundance of fish > biodiversity of fish

– socioeconomic valuation – recreational values - results

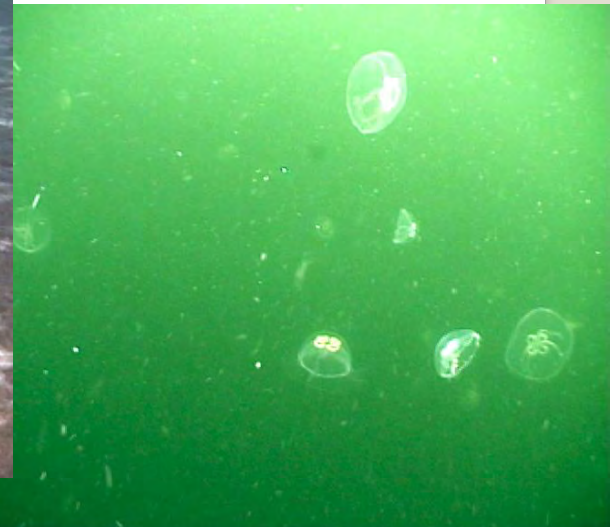
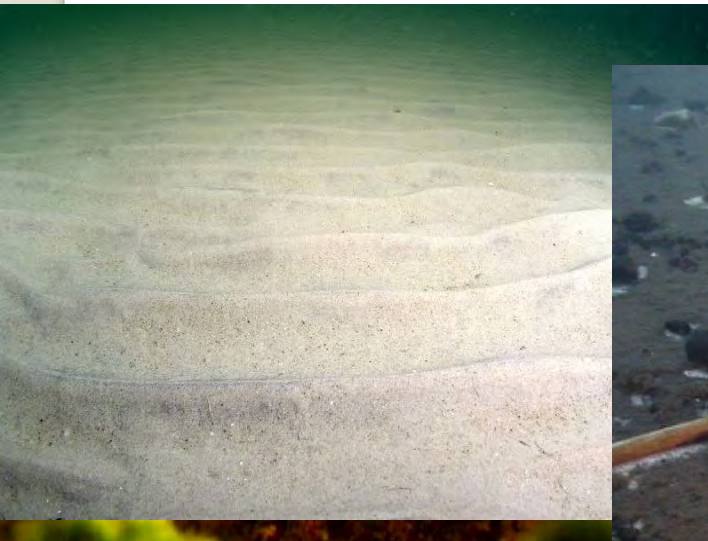
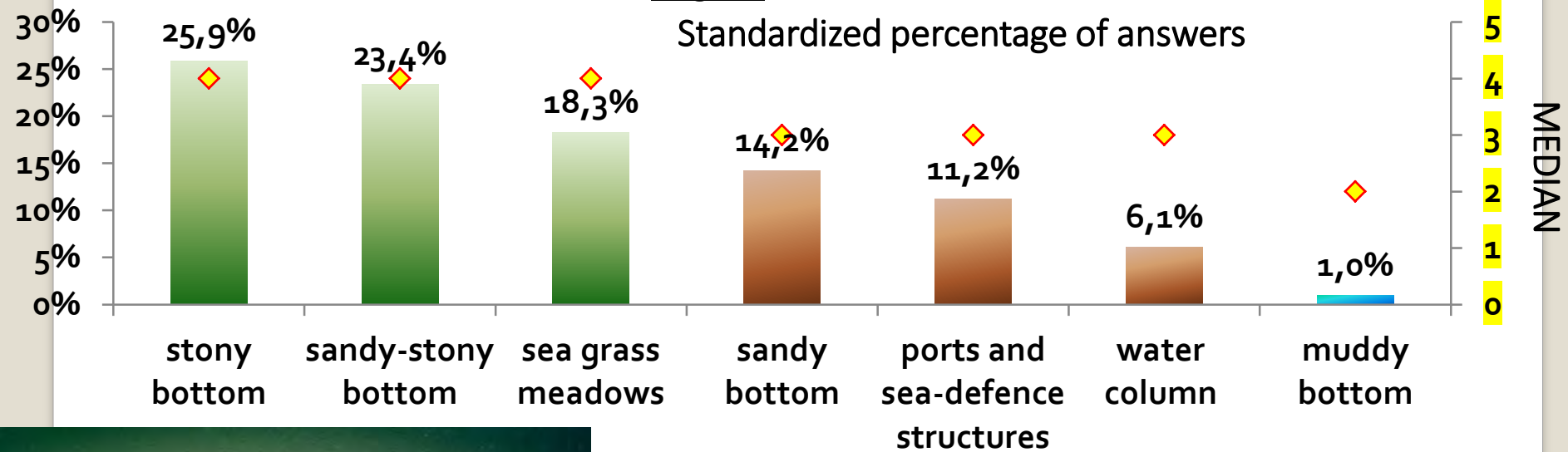
	Answers		Percent of observation
	N	Percent	
	341	100,00%	288,98%
sea trout <i>Salmo trutta trutta</i>	59	17,3%	50,0%
cod <i>Gadus morhua</i>	51	15,0%	43,2%
Atlantic salmon <i>Salmo salar</i>	50	14,7%	42,4%
garpike <i>Belone belone</i>	49	14,4%	41,5%
pike perch <i>Stizostedion lucioperca</i>	31	9,1%	26,3%
pike <i>Esox lucius</i>	29	8,5%	24,6%
eel <i>Anaquilla anaquilla</i>	24	7,0%	20,3%
flounder/turbot <i>Platichthys flesus/ Psetta maxima</i>	22	6,5%	18,6%
Atlantic herring <i>Clupea harengus</i>	12	3,5%	10,2%
perch <i>Perca fluviatilis</i>	9	2,6%	7,6%
roach <i>Rutilus rutilus</i>	5	1,5%	4,2%

Target species



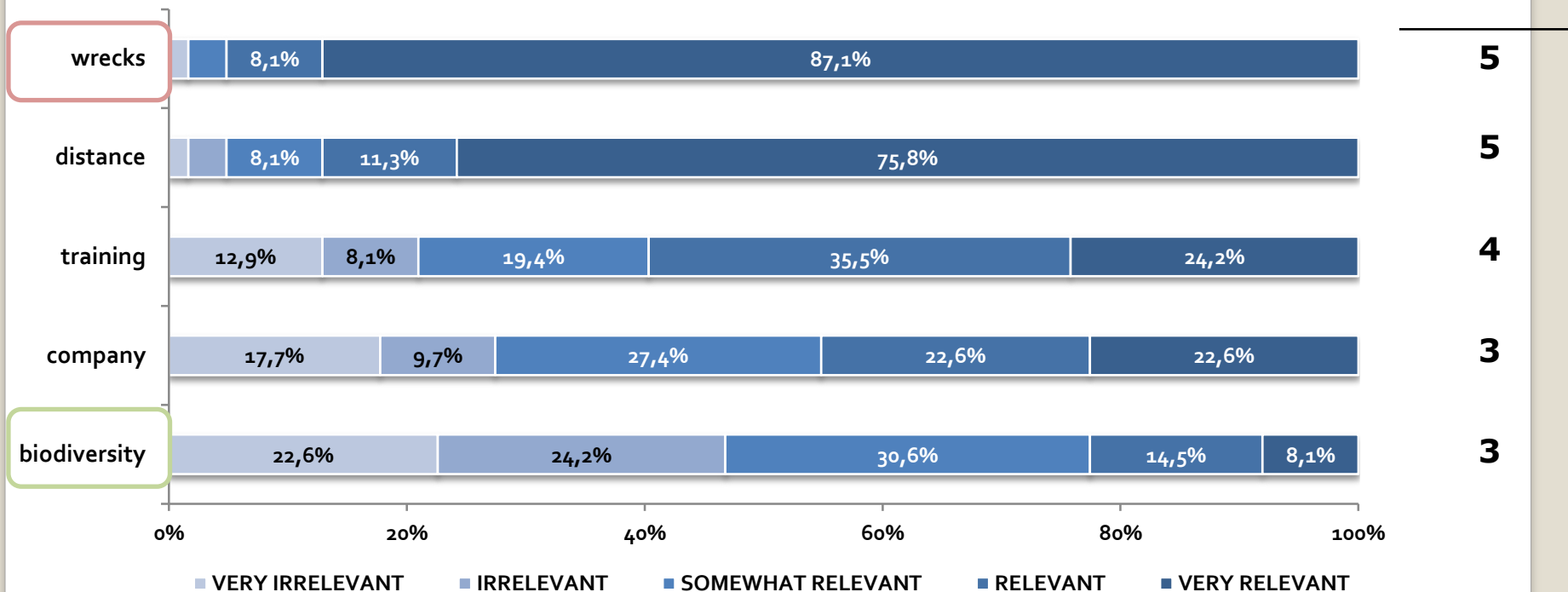
– socioeconomic valuation – recreational values - results

Most valuable/suitable HABITATS for anglers



– socioeconomic valuation – recreational values - results

Reasons for choosing the Gulf of Gdansk as a diving destination.



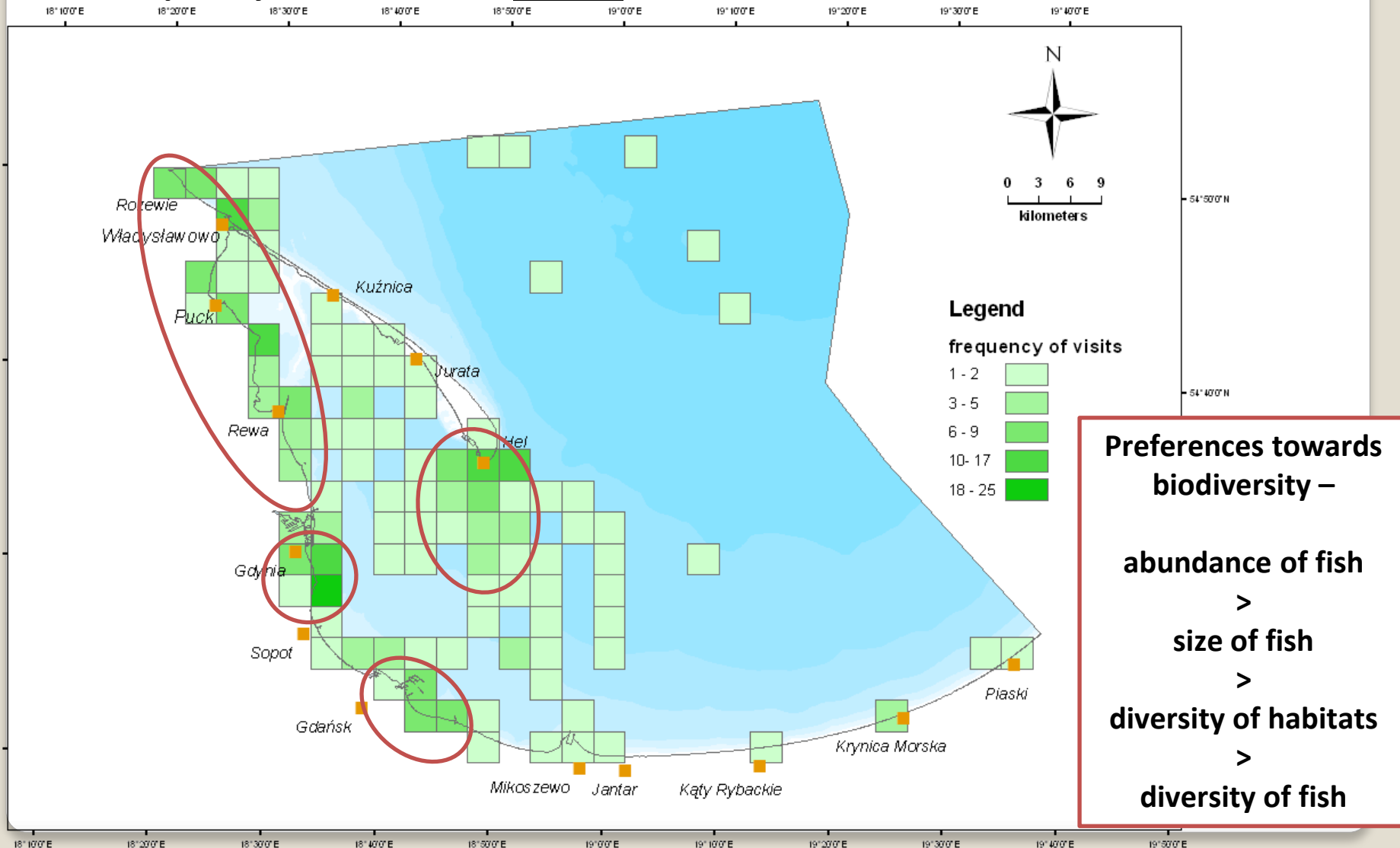
Wrecks – main driving force for divers, while visiting the Gulf of Gdansk
(visiting divers consider wreck diving **more relevant** than local divers – Kruskal-Wallis; $p < 0,01$)

Biodiversity is considered by one third of divers as 'somewhat relevant'.

For many divers (46,8%) biodiversity is 'irrelevant' or 'very irrelevant'

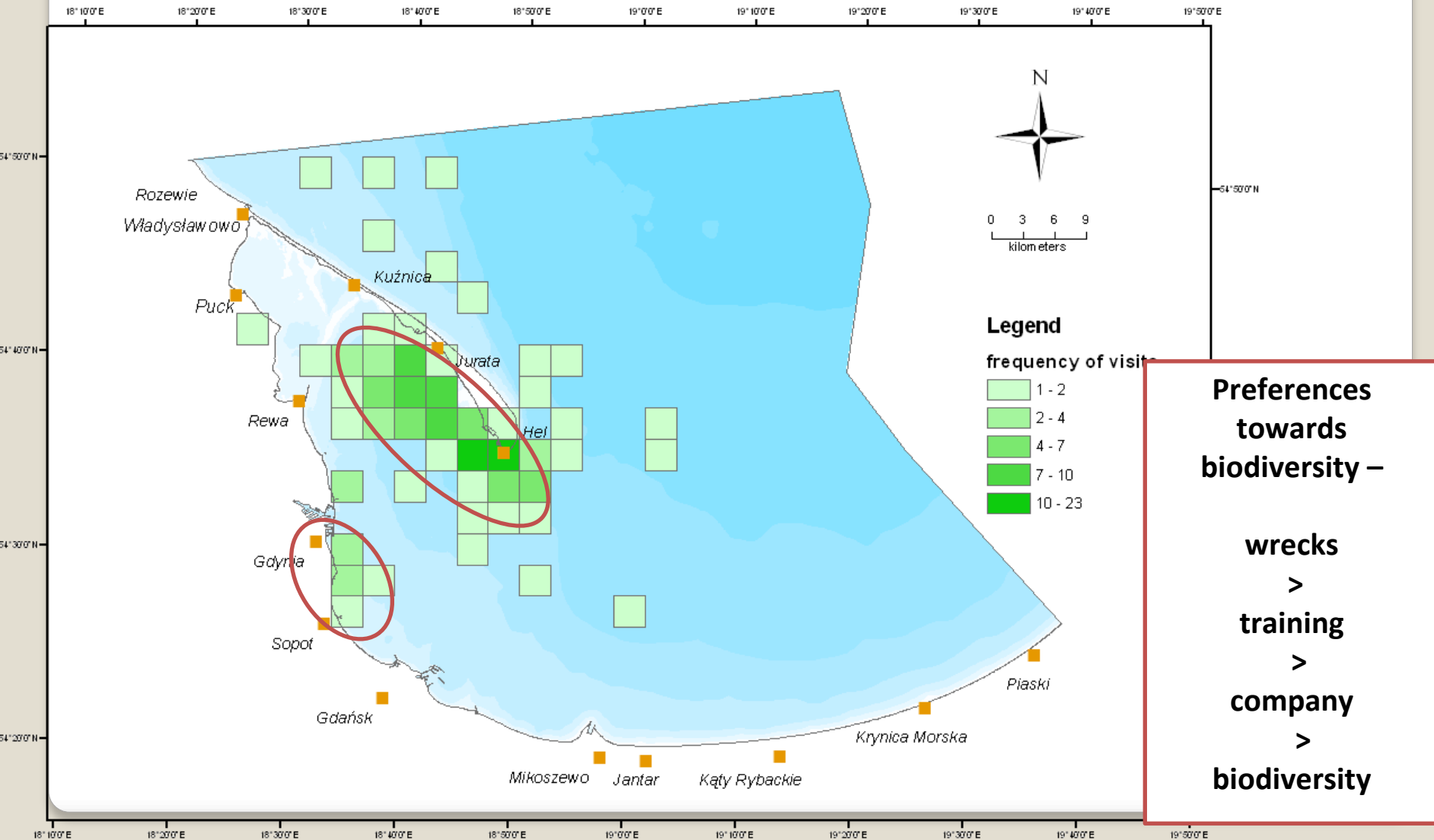
– socioeconomic valuation – recreational values - results

Most frequently visited sites for angling



– socioeconomic valuation – recreational values - results

Most frequently visited sites for diving



Thank you for your attention !

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