

Growing
ideas
through
networks



UAS-aided bedform and habitat mapping of Bolata Cove, Bulgarian Black Sea coast

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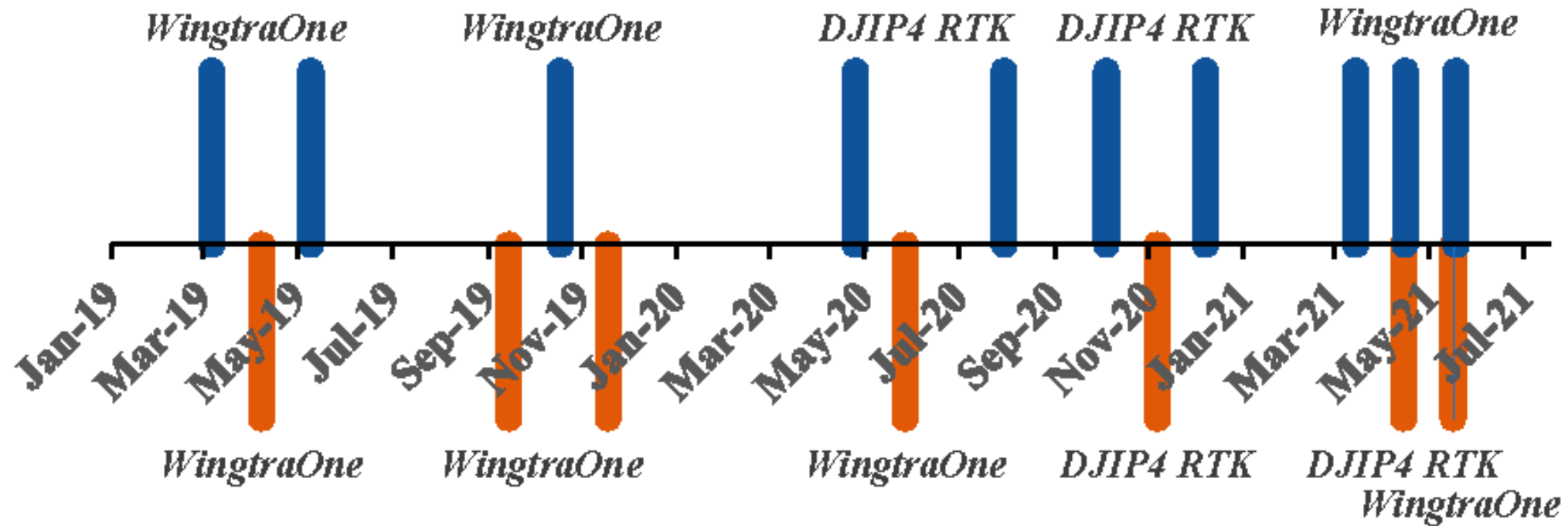
INTRODUCTION



- **Geomorphological mapping (+ sedimentological mapping + biological sampling) - the backbone of seabed habitat mapping;**
- **Geomorphological mapping + vegetation mapping – essence of coastal habitat mapping;**
- **Geomorphic hard- and soft-bottom features of the shallow seabed – corresponding to important marine benthic habitats**  **GES assessment pursuant to the MSFD;**
- **Coastal beaches, dunes, erosional cliffs, etc. – also hosting important natural habitats;**
- **Seabed & coastal habitats - subject to protection under European and Bulgarian national legislation;**
- **Related to the occurrence of erosional (abrasional) and depositional coastal sectors;**
- **Intensive spatio-temporal dynamics**  **morphological changes;**
- **Require regular coastal monitoring and frequent mapping surveys.**



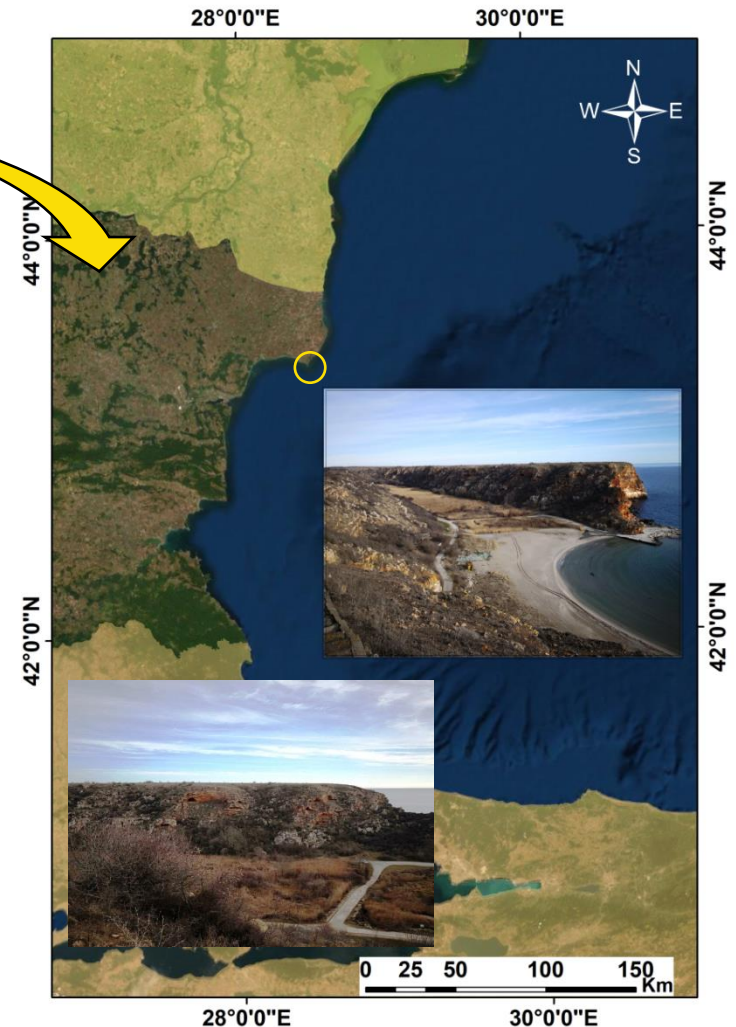
Timeline of UAV surveys



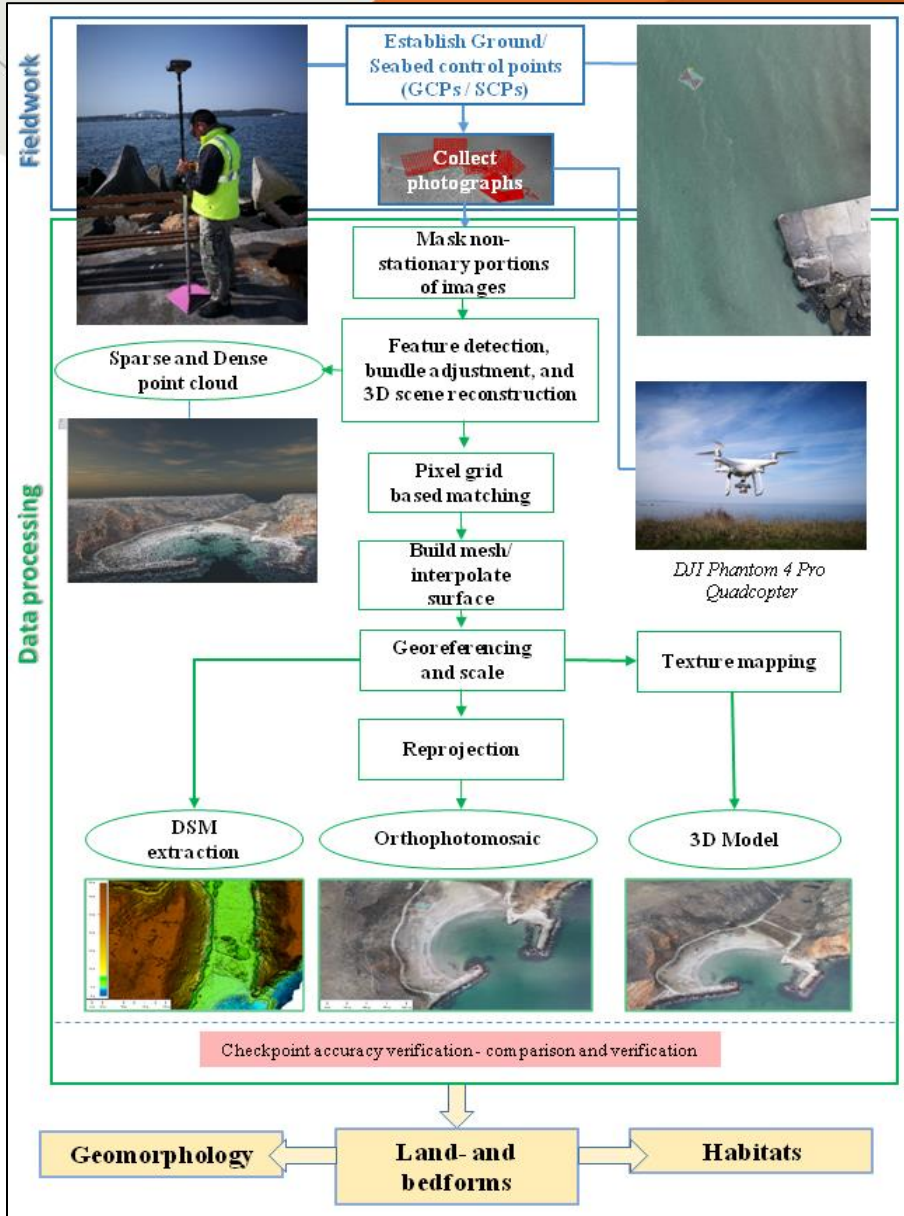
STUDY AREA



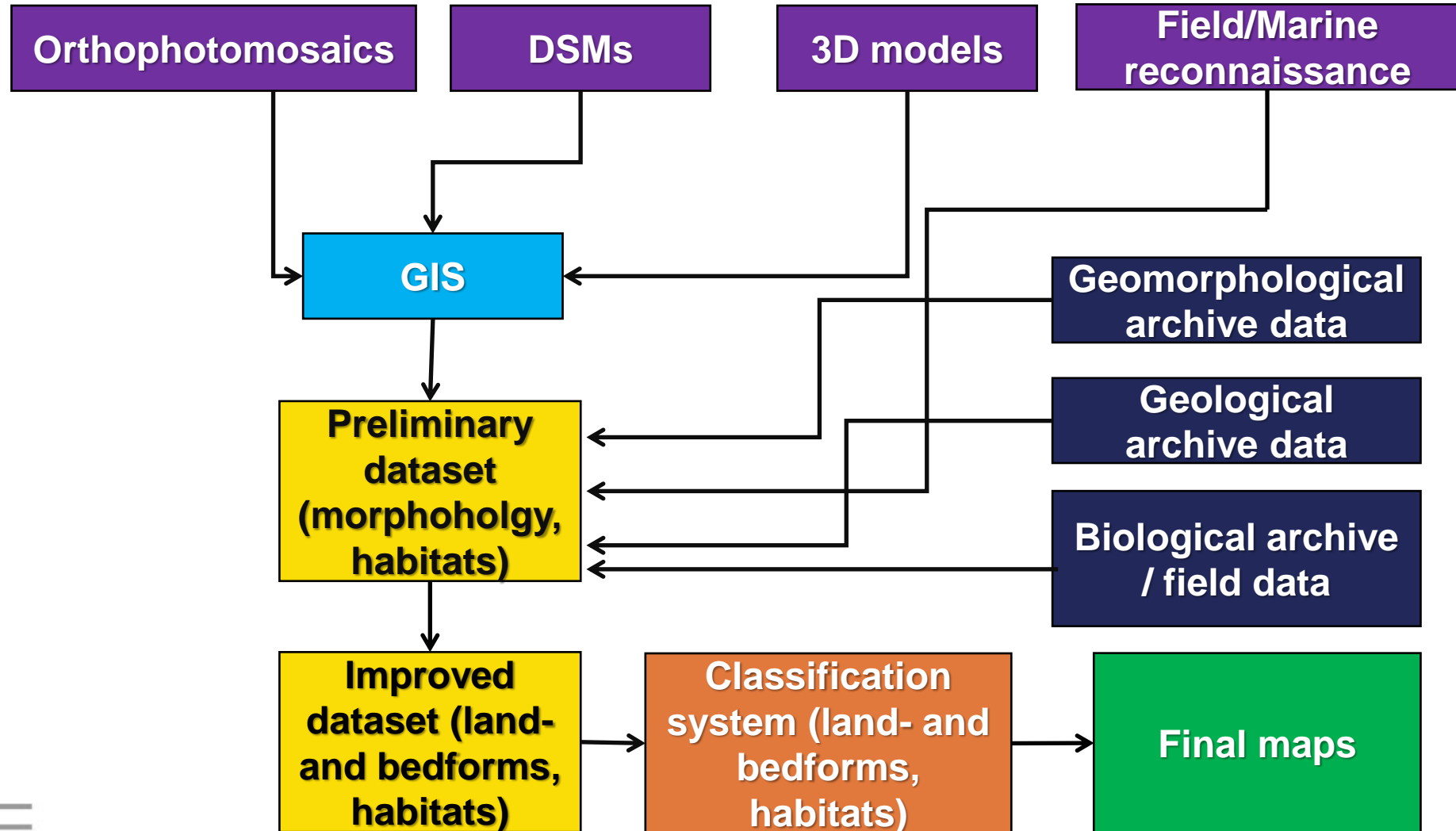
- Maritime Dobrudzha cross-border region (Romania-Bulgaria);
- Kaliakra Nature / Archaeological Reserve;
- (Complex) Kaliakra NATURA 2000 protected site (HD/BD);
- Almost no tree cover, ideal for UAS mapping;
- Xeric petrophytic steppes;
- Open and semi-open karst terrains, limestone cliffs;
- Erosional and depositional coastal land- and bedforms.



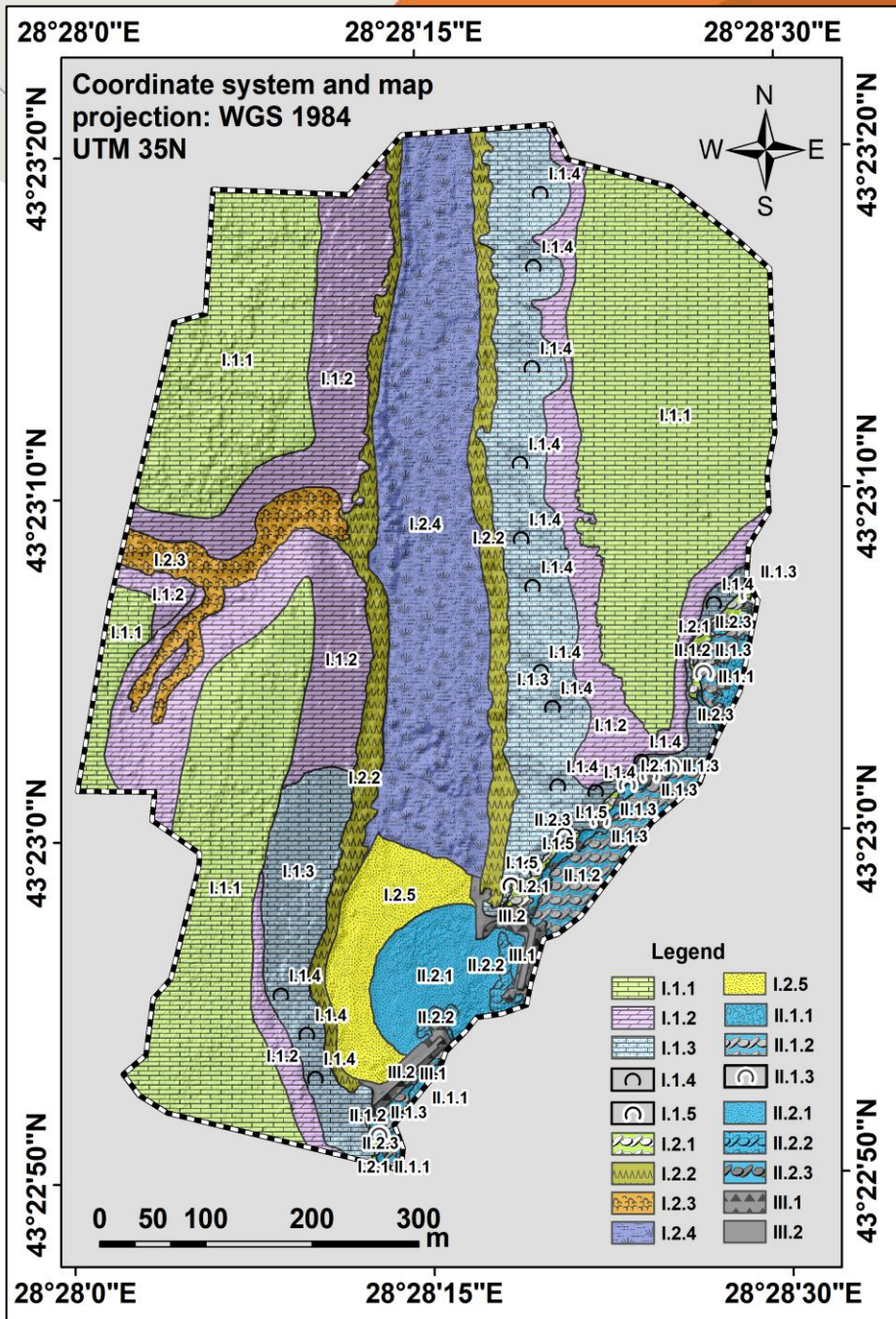
METHODOLOGY: STAGE 1 (UAS SURVEYS)



METHODOLOGY: STAGE 2 (GEOMORPHOLOGICAL & HABITAT MAPPING IN GIS)



IDENTIFIED LAND- AND BEDFORMS



I.1.1. Denudational surfaces

I.1.2. Erosional-denudational limestone slopes

I.1.3. Erosional limestone cliffs

I.1.4. Karst notches

I.1.5. Subaereal wave-cut (abrasional) notches

I.2.1. Cliff bases with block and boulder accumulations

I.2.2. Cliff/slope bases with talus deposits (screes)

I.2.3. Karst valley depositional bottoms

I.2.4. Depositional firths

I.2.5. Depositional sandy beaches with embryonic dunes

II.1.1. Abrasional platforms with pebbles, gravels and coarse sand

II.1.2. Abrasional platforms with limestone boulder and cobble depositions

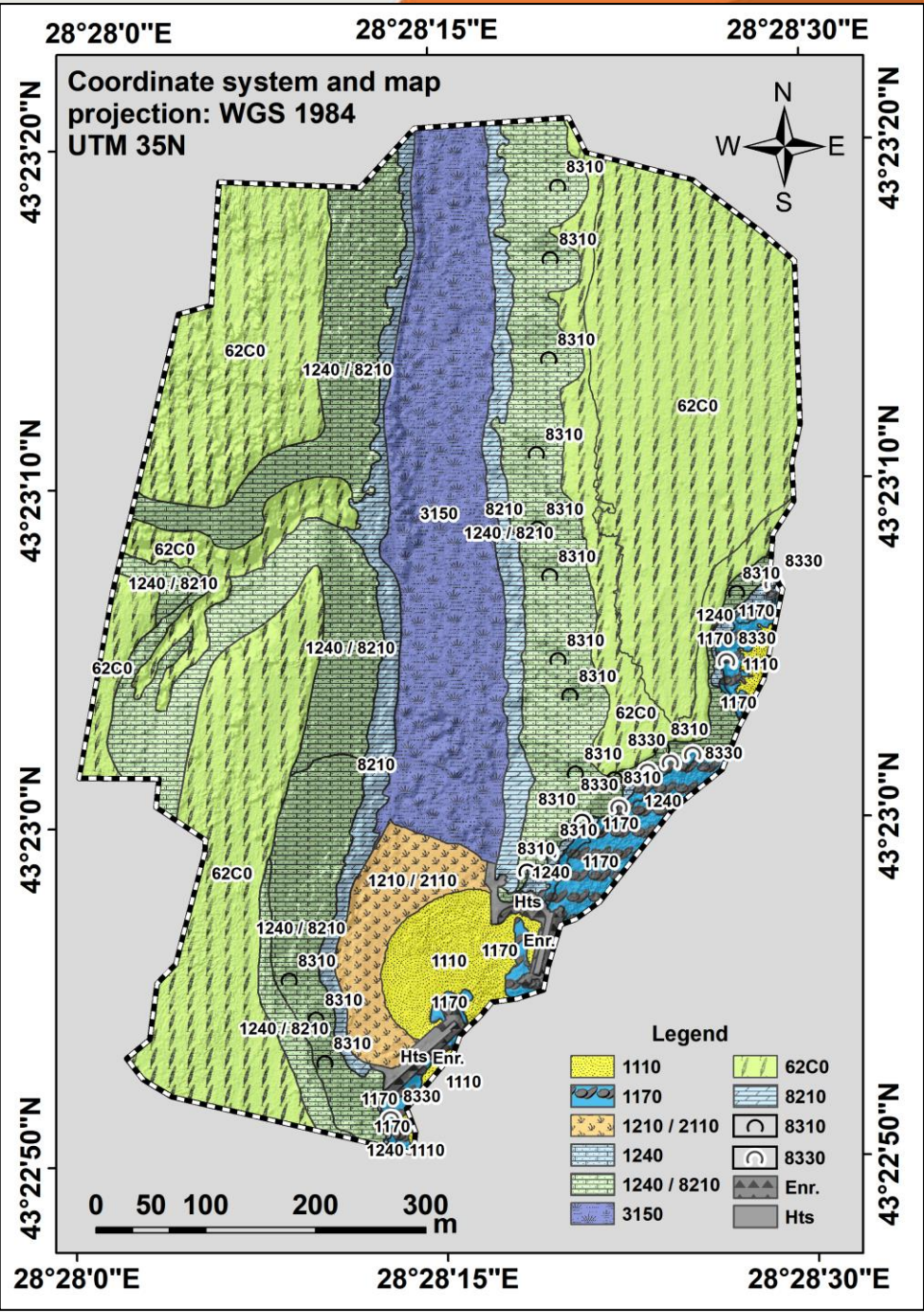
II.1.3. Mediolittoral wave-cut (abrasional) notches

II.2.1. Beach-face depositional platforms with sandy seabed

II.2.2. Beach-face depositional platforms with limestone boulder and cobble accumulations on sandy seabed

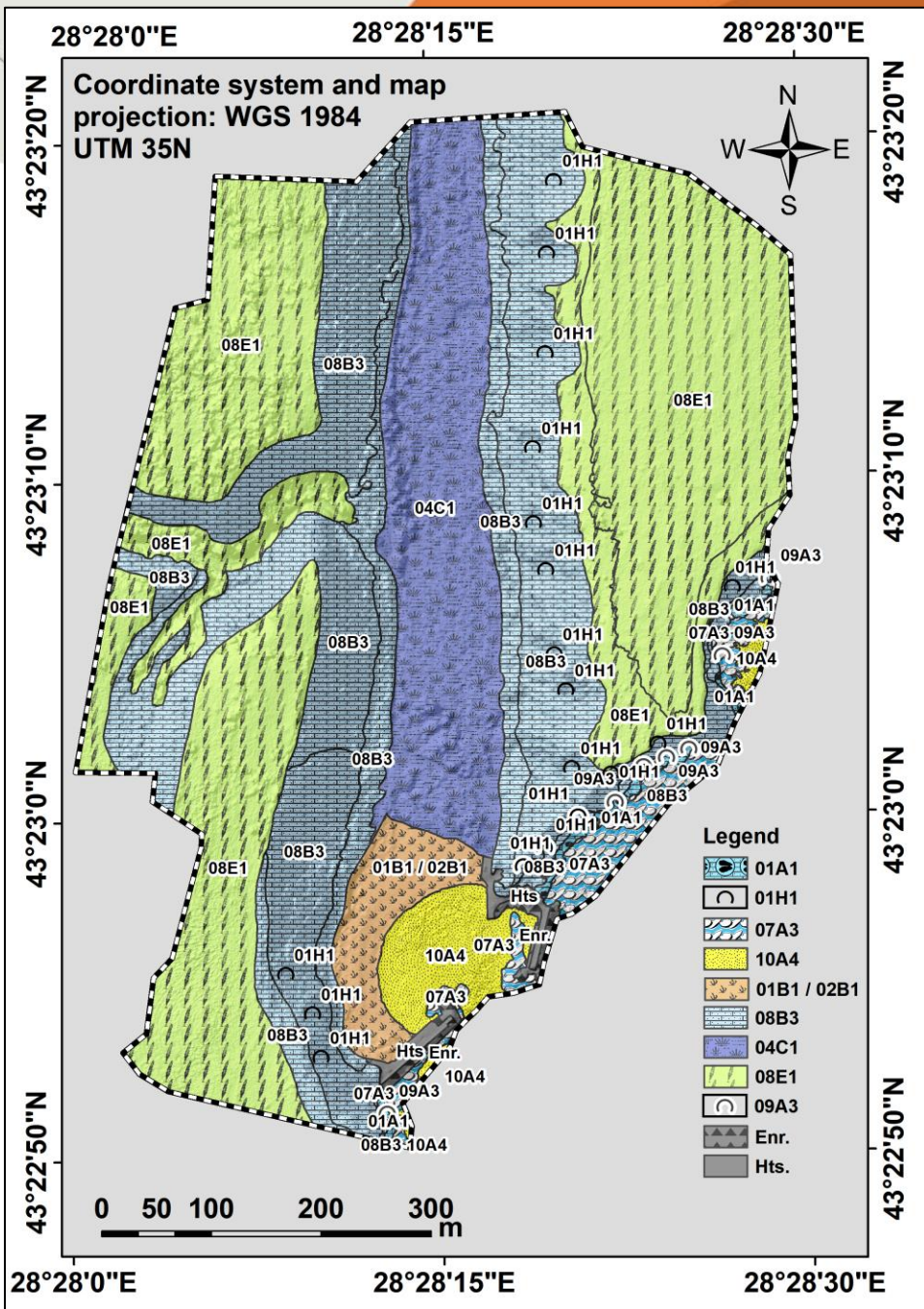
II.2.3. Mediolittoral cliff bases with limestone boulder and cobble depositions

CORRESPONDING NATURA 2000 HABITATS



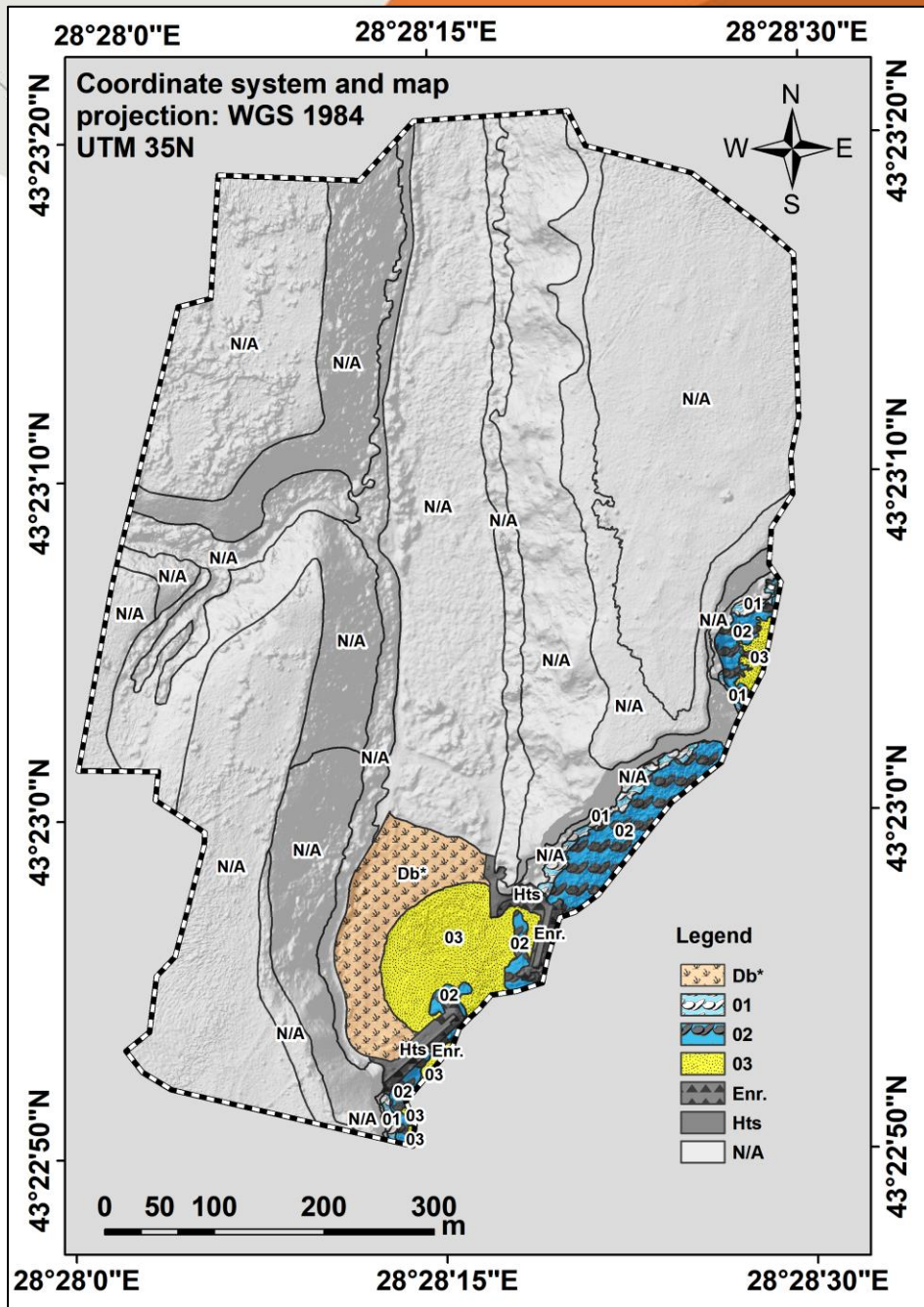
- 1210 Annual vegetation of drift lines
- 2110 Embryonic shifting dunes
- 1240 Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp.
- 8210 Calcareous rocky slopes with chasmophytic vegetation
- 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation
- 62C0 Ponto-Sarmatic steppes
- 8310 Caves not open to the public
- 8330 Submerged or partially submerged sea caves
- 1110 Sandbanks which are slightly covered by sea water all the time
- 1170 Reefs

CORRESPONDING HABITATS: RED DATA BOOK OF BULGARIA



- 01A1. Black mussels and/or barnacle communities on mediolittoral rocks
- 07A3. Infralittoral rocks and other hard substrates
- 10A4. Sublittoral sands
- 09A3. Sea caves
- 01B1. Vegetation on the Black Sea sand beaches
- 02B1. Black Sea embryonic dunes
- 08B3. Sea-cliff vegetation
- 04C1. Natural or semi-natural mesotrophic to eutrophic lakes and marshes with macrophytic vegetation
- 08E1. Western-Pontic petrophytic steppes
- 01H1. Cave entrances

CORRESPONDING MSFD HABITATS:

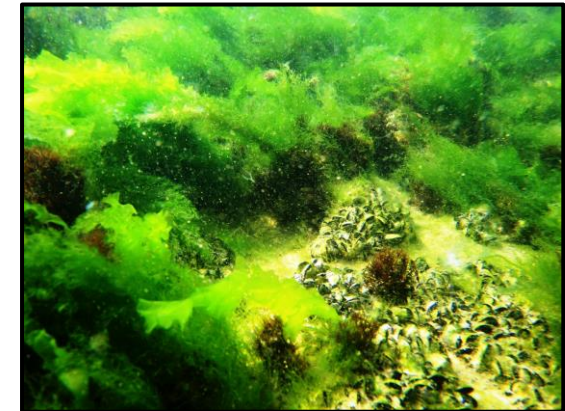
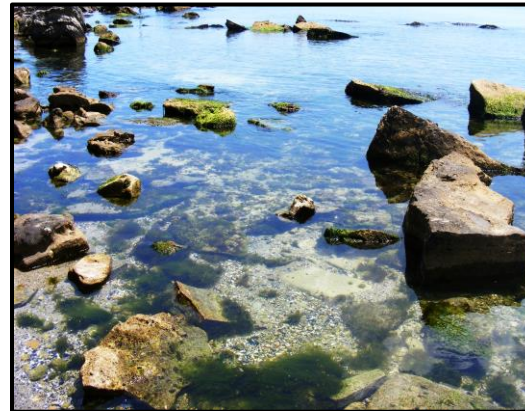


Db - *Beaches and dunes

01. Littoral rocks and biogenic reefs

02. Infralittoral rocks and biogenic reefs

03. Infralittoral sands



LANDFORMS	NATURA 2000 HABITATS	BULGARIAN RED DATA BOOK HABITATS	CATEGORY
I.1.1. Denudational surfaces	62C0 Ponto-Sarmatic steppes	08E1. Western-Pontic petrophytic steppes	EN
I.1.2. Erosional-denudational limestone slopes	1240 Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.	08E1. Western-Pontic petrophytic steppes	EN
	8210 Calcareous rocky slopes with chasmophytic vegetation	08B3. Sea-cliff vegetation	EN
	62C0 Ponto-Sarmatic steppes		
I.1.3. Erosional limestone cliffs	1240 Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.	08B3. Sea-cliff vegetation	EN
	8210 Calcareous rocky slopes with chasmophytic vegetation		
I.1.4. Karst notches	8310 Caves not open to the public	01H1. Cave entrances	VU
I.1.5. Wave-cut (abrasional) notches			
I.2.1. Cliff bases with limestone block and boulder accumulations	1240 Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.	08B3. Sea-cliff vegetation	EN
I.2.2. Cliff/slope bases with talus deposits (screes)	8210 Calcareous rocky slopes with chasmophytic vegetation	08B3. Sea-cliff vegetation	EN
I.2.3. Karst valley depositional bottoms	62C0 Ponto-Sarmatic steppes	08E1. Western-Pontic petrophytic steppes	EN
I.2.4. Depositional firths	3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation	04C1. Natural or semi-natural mesotrophic to eutrophic lakes and marshes with macrophytic vegetation	EN

LAND- OR BEDFORMS	NATURA 2000 HABITAT TYPES	BULGARIAN RED DATA BOOK HABITAT TYPES	MSFD HABITAT TYPES	CATEGORY
I.2.5. Depositional sandy beaches with embryonic dunes	1210 Annual vegetation of drift lines	01B1. Vegetation on the Black Sea sand beaches	*Not included, however subject to GES assessment under D10 (marine litter)	EN
	2110 Embryonic shifting dunes	02B1. Black Sea embryonic dunes		EN
II.1.1. Abrasional platforms with pebbles, gravels and coarse sand	1110 Sandbanks which are slightly covered by sea water all the time	10A4. Sublittoral sands	Infralittoral sands	NT
II.1.2. Abrasional platforms with limestone boulder and cobble depositions	1170 Reefs	07A3. Infralittoral rocks and other hard substrates	Infralittoral rocks and biogenic reefs	VU
II.1.3. Wave-cut (abrasional) notches	8330 Submerged or partially submerged sea caves	09A3. Sea caves	N/A	EN
II.2.1. Beach-face depositional platforms with sandy seabed	1110 Sandbanks which are slightly covered by sea water all the time	10A4. Sublittoral sands	Infralittoral sands	NT
II.2.2. Beach-face depositional platforms with limestone boulder and cobble accumulations on sandy seabed	1170 Reefs	07A3. Infralittoral rocks and other hard substrates	Infralittoral rocks and biogenic reefs	VU
II.2.3. Mediolittoral cliff bases with limestone boulder and cobble depositions	1170 Reefs	01A1. Black mussels and/or barnacle communities on mediolittoral rocks	Littoral rocks and biogenic reefs	VU

DISCUSSION AND CONCLUSIONS

- Significantly facilitated process of shallow bedform/ coastal landform mapping and psammophilous/aquatic vegetation identification, habitats interpretation and classification;
- Repetitive surveys required for monitoring needs;
- 2019-2021 - the very first seasons when UAS mapping campaigns have been applied;
- Deductions regarding long-term trends - unsuitable without proper comparisons to historical data;
- Historical analyses and comparisons vs. archive data – carried out during the past autumn-winter months;
- Significant morphological evolution and habitat conversion trends;
- Quantitative dimensions of coastal and seabed change are currently being assessed.



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