

Towards the Monitoring of Dumped Munitions Threats NATO SfP 984589 Project - 2013 – 2016

## Precisely coordinated multiple sediment sampling in close vicinity of underwater objects

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#### Motivation

10 years ago started the 1<sup>st</sup> International Baltic project MERCW. Since that time, every year brings more and more detected underwater objects, which could appear to be unpleasant for environment and humans.

Relationship of underwater objects and dumped chemical munitions is not sufficiently studied yet.

Task

Precise sampling from close vicinity of potentially dangerous objects is necessary to evaluate a rate of such danger.



### Aim of this work

- To satisfy an immediate want of MODUM partners in samples for analyses,
- To formulate optimal decision for further researches on the base of obtained experience.

#### Main requirements

Key instrument – light multi grab sampler - is necessary, which could be used from small easily anchored boats.

The system must operate remotely under control of video and positioning devices.

### **Tested technical solutions**



Ingesting cylinders



Horizontally moving grabs



Grab on rotating arm

#### Practical solutions (2014)





Cassette sampler with 8 ingesting cylinders



#### Practical solutions (2014)



6-grab cassette sampler with rotating arms.

Bags with sediment



### Practical solutions (Sept. 2015)







### Work (2015)



#### Field work arrangement

- 1. Objects' positions were detected during AUV mission.
- 2. To perform sampling mission, a boat with sampling system must control its position using two anchors
- There are two options: inflatable Zodiac light but small and open, and tuna-boat Nord III (15m, 22 t) –more comfortable but heavy. Both options were tested.

#### Maneuvering near underwater objects using 2 anchors and GPS



1 – a boat
2, 3 – anchors
4, 5 – ropes
6 – an object
7 - resulting motion during
Sampling
8 – wind direction

#### **Results obtained with Zodiac**















#### Results obtained by tunaboat Nord 3 on the Gdaņsk polygon



# Results obtained by tunaboat Nord 3 (zoomed)



#### Object No9

36	54°45.352'19°07.101'25.09.2015	9:57:36
37	54°45.358'19°07.131'25.09.2015	9:59:02
38	54°45.363'19°07.144'25.09.2015	9:59:50
39	54°45.364'19°07.165'25.09.2015	10:01:18
41	54°45.363'19°07.208'25.09.2015	10:03:40
42	54°45.362'19°07.215'25.09.2015	10:04:33

#### **Object No8**

43	54°45.402'19°07.388'25.09.2015	11:56:23
44	54°45.400'19°07.414'25.09.2015	11:57:36
45	54°45.401'19°07.428'25.09.2015	11:58:23
46	54°45.400'19°07.436'25.09.2015	11:59:15
47	54°45.396'19°07.443'25.09.2015	12:00:34
48	54°45.396'19°07.461'25.09.2015	12:05:41
49	54°45.398'19°07.471'25.09.2015	12:08:56

#### Disadvantage

Accuracy of detection of sampling position is not satisfactory. GPS on the boat doesn't guaranty exact positioning on the bottom

Our next step is to make inspected objects visible for Sonar or other tools. Having coordinates of some object, one must identify it by ROV, then mark the object and sampling device as well by passive or active beacons, and then control their respective positions by Sector Sonar or USBL during sampling mission. Our experiments were promising.

#### Improvement of the system





- 1, 4, 8 floats 2 – Sonar
- 3, 6 threads
- 5 cable
- 7 load
- 9 rope

Float (marks the object)

Sonar

Sampler is visible for Sonar not worse than special target

ROV is necessary to identify the object

On a boat, under development there are winches and anchors, which sizes are limited.

Light plough-like anchor and active pulley as alternative to winch were successfully tested



#### Conclusions

- 1. The existing sampling technique is good enough for practical application.
- 2. We understand what to do the next to meet project requirements.

#### Thank partners for collaboration!

#### Thank everybody for attention!