St Petersburg University

BIO GEO HAB

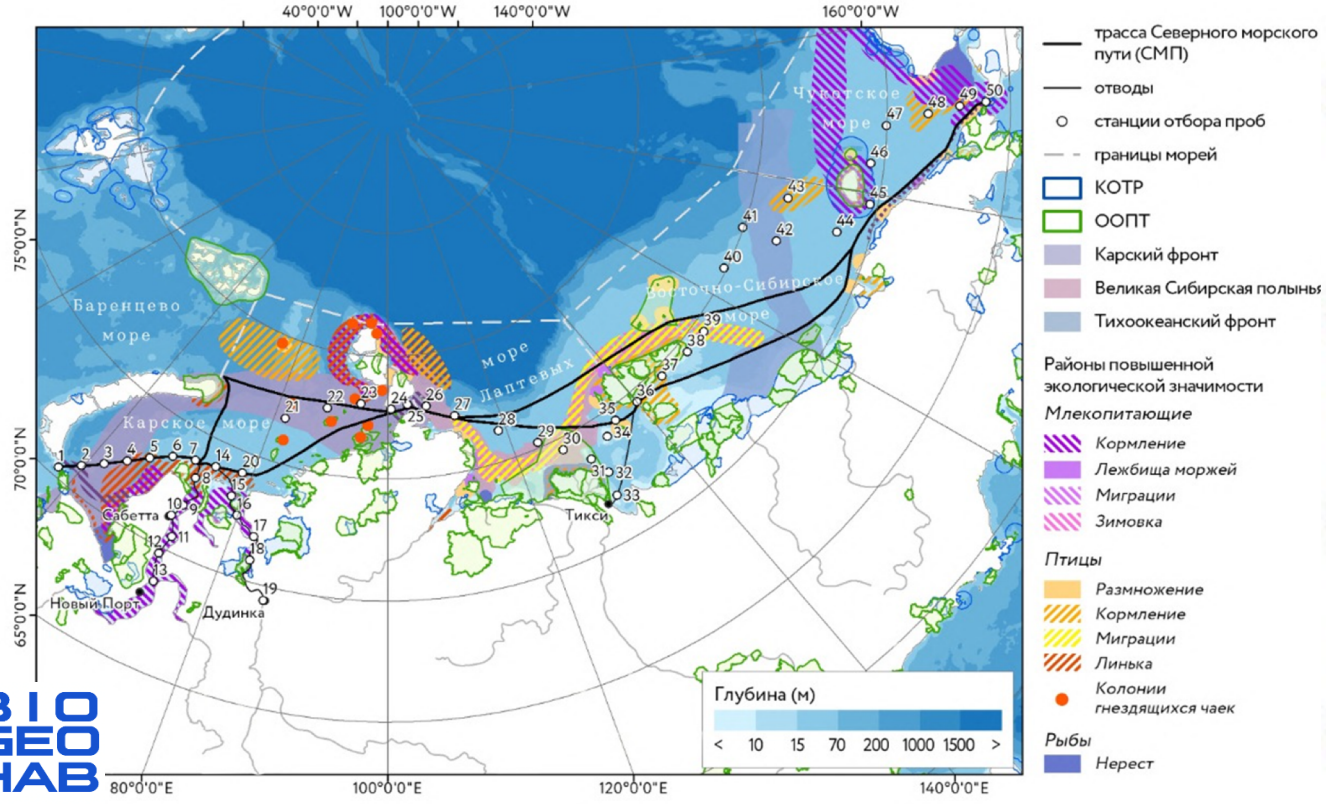
Underwater biotope mapping: automatic processing of underwater video data

Oleg Iakushkin, Ekaterina Pavlova, Anastasiya lavrova, Evgeniy Pen, Anna Frikh-Khar, Yana Terekhina, Anna Bulanova, Nikolay Shabalin, and Olga Sedova

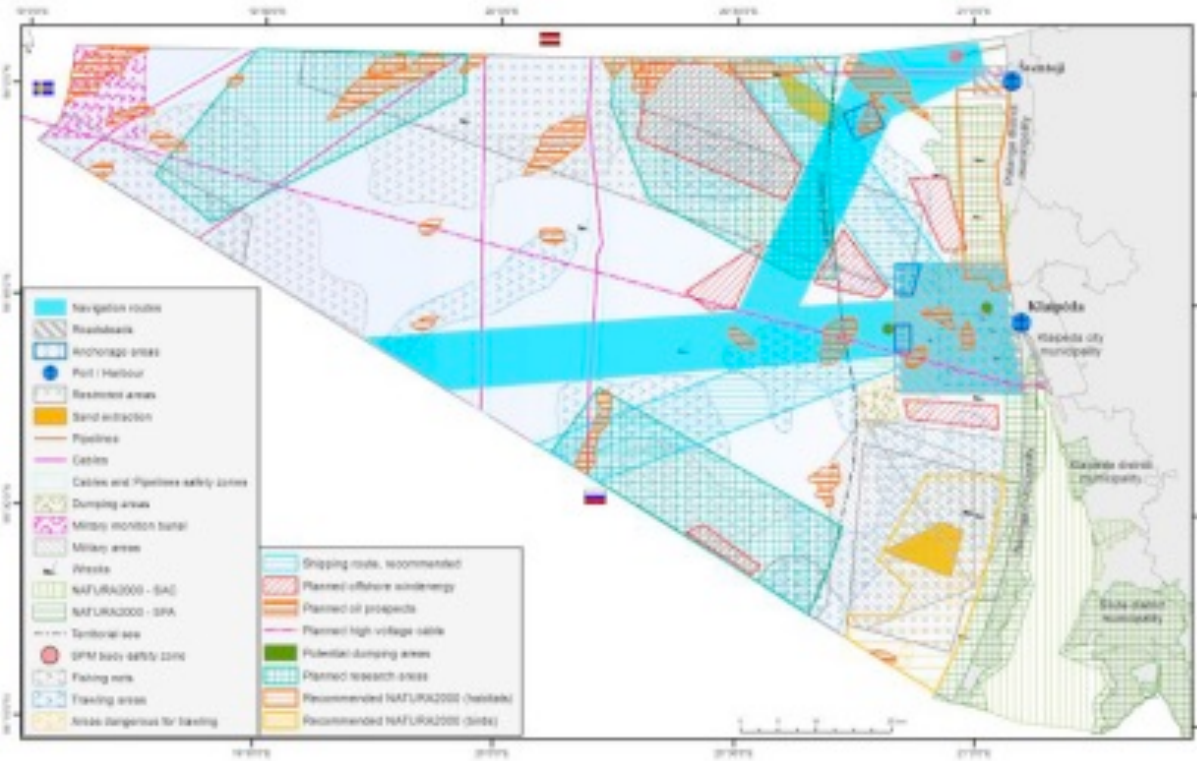
Why scan the sea?

1. Fish biomes are heavily correlated with sea bottom
2. Construction projects require sea bed surveys for permissions and compensations
3. Biomes on the sea floor tend to correlate with minerals and deposits under the sea bed

Construction and operation of structures on the Arctic shelf of the Russian Federation



Marine Spatial Planning

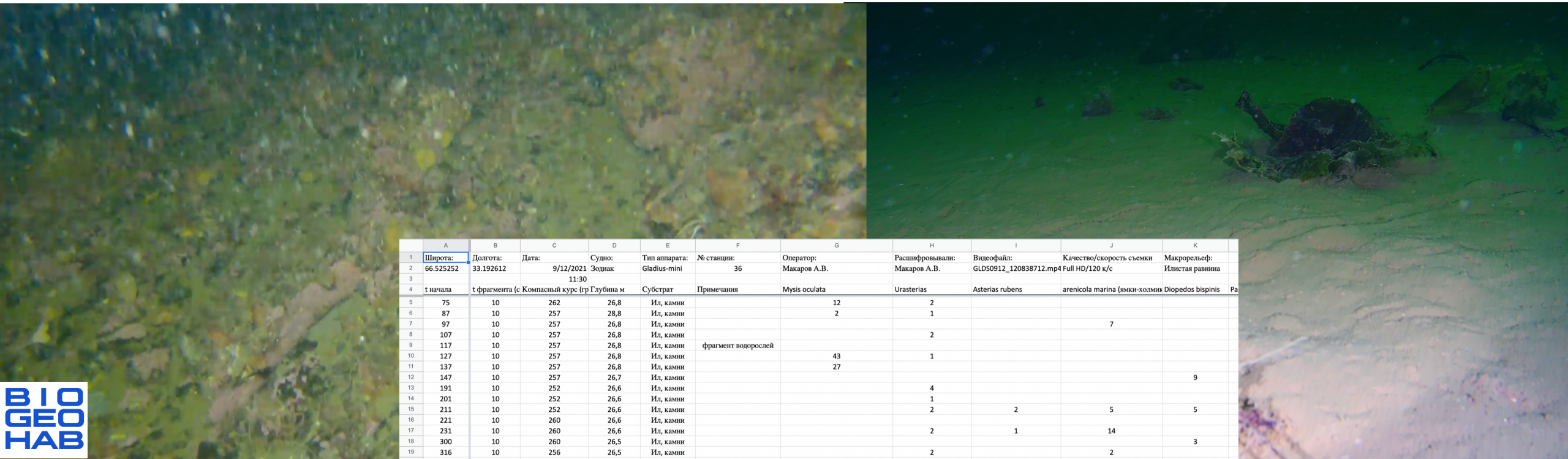


BIO GEO HAB

Problem definition

It takes lots of time to turn a video into a table

- A specially trained scientists looks thru the video and classifies plants and animals
- It takes approximately **2 hours** for him to **process 5 minute video**
- A scientist has specialized training that allows him to see not only images but also integrate context

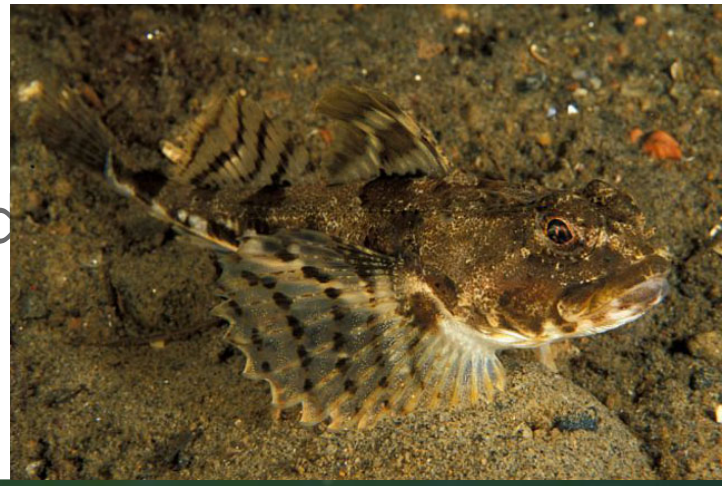


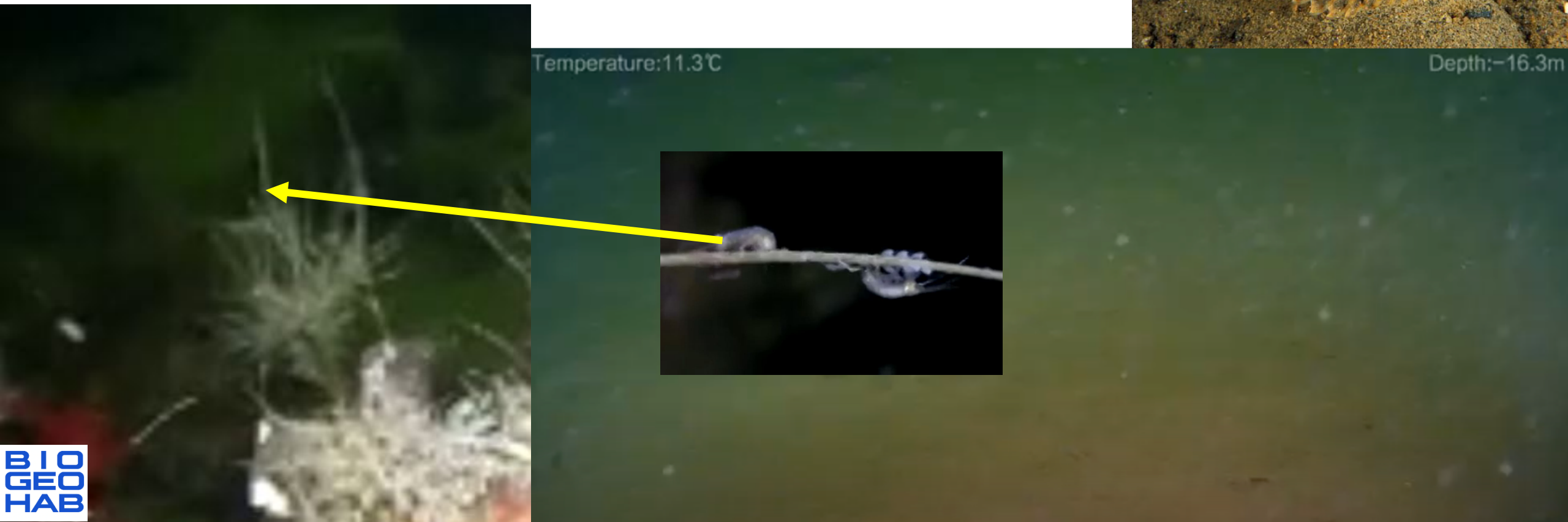
	A	B	C	D	E	F	G	H	I	J	K
1	Широта:	Долгота:	Дата:	Судно:	Тип аппарата:	№ станции:	Оператор:	Расшифровывали:	Видеофайл:	Качество/скорость съемки	Макрорельеф:
2	66.525252	33.192612	9/12/2021	Зодиак	Gladius-mini	36	Макаров А.В.	Макаров А.В.	GLDS0912_120838712.mp4	Full HD/120 к/с	Илистая равнина
3			11:30								
4	t начала	t фрагмента (с	Компасный курс (гр	Глубина м	Субстрат	Примечания	Mysis oculata	Urasterias	Asterias rubens	arenicola marina (ямки-холмик	Diopedos bispinis
5	75	10	262	26,8	Ил, камни		12	2			
6	87	10	257	28,8	Ил, камни		2	1			
7	97	10	257	26,8	Ил, камни					7	
8	107	10	257	26,8	Ил, камни			2			
9	117	10	257	26,8	Ил, камни	фрагмент водорослей					
10	127	10	257	26,8	Ил, камни		43	1			
11	137	10	257	26,8	Ил, камни		27				
12	147	10	257	26,7	Ил, камни						9
13	191	10	252	26,6	Ил, камни			4			
14	201	10	252	26,6	Ил, камни			1			
15	211	10	252	26,6	Ил, камни			2	2	5	5
16	221	10	260	26,6	Ил, камни						
17	231	10	260	26,6	Ил, камни			2	1	14	
18	300	10	260	26,5	Ил, камни						3
19	316	10	256	26,5	Ил, камни			2		2	

BIO GEO HAB

Problem definition

- Videos are blurry chunky and low resolution
- There is plankton, dust and excrement's flying all around
- Animals have a wide size differential

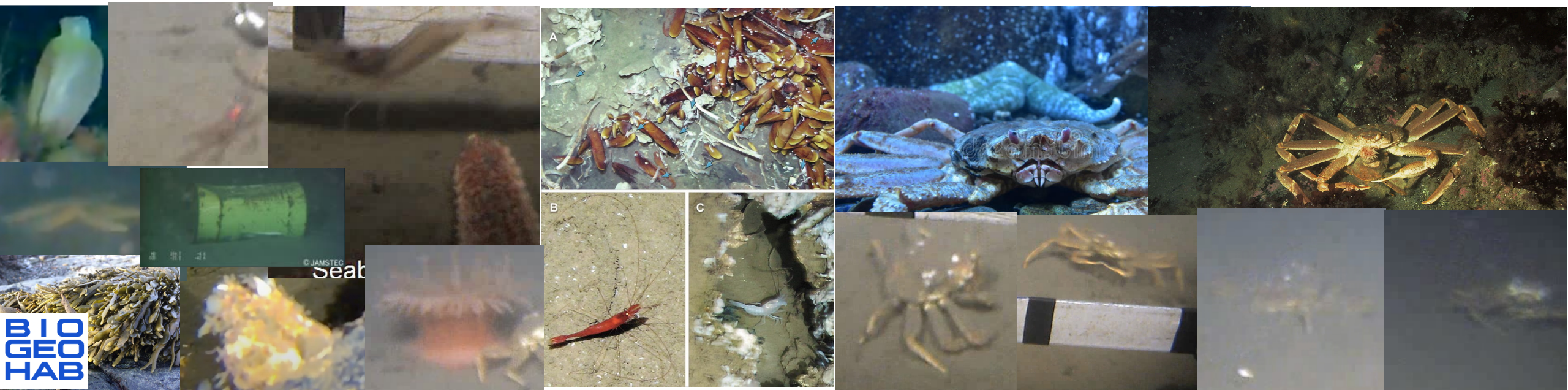




BIO GEO HAB

Our dataset and ResNet training

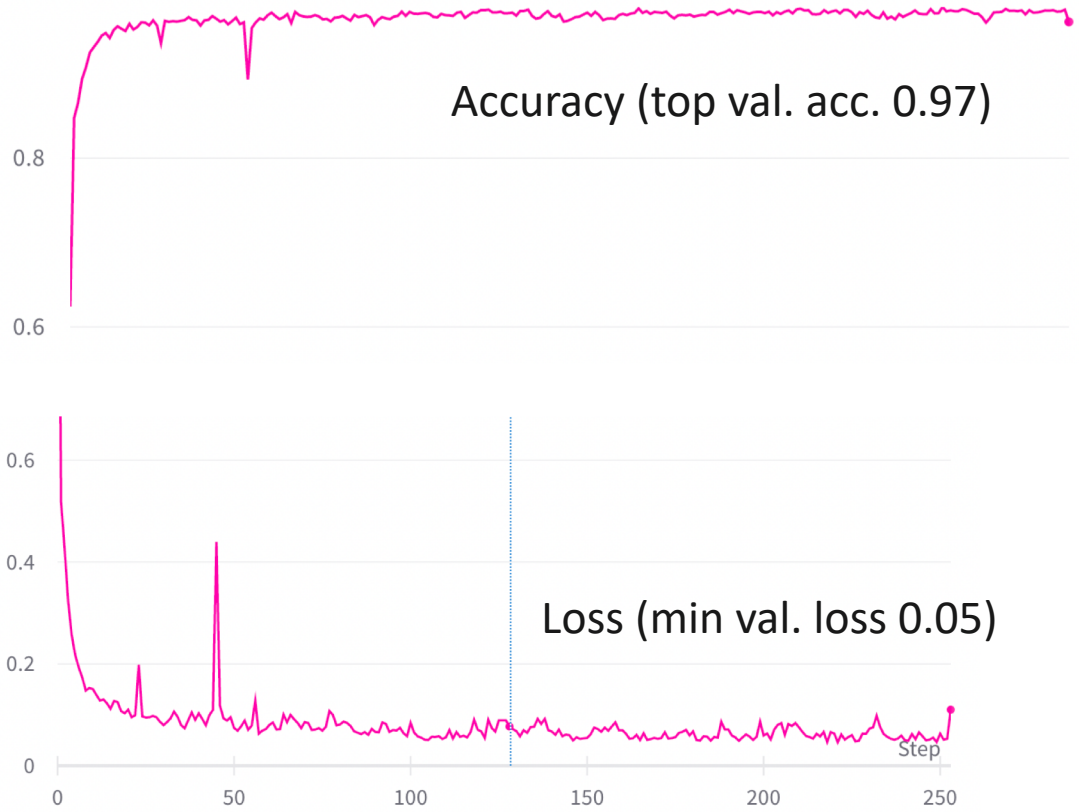
- **36 classes** special for for White Sea (30 animals, trash, none, human, fish, 2 types of plants)
- **60\40 mix** of chunks from video to internet aggregated images



Our dataset and ResNet training

- During training all is scaled down to **250x250**
- Training is performed **from pretrained ResNet50** on 1k classes, all layer involved (**2h on A30**)
- Augmentations performed

Resize((250, 250)),
AutoAugment(),
RandomHorizontalFlip(),
RandomVerticalFlip(),
Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225]),
RandomErasing(),
Lambda(*lambda* x : x + torch.randn_like(x)*0.2)



BIO GEO HAB

Our solution

1. Remove blurry frames, take only key frames
2. Split frames into chunks
3. Perform ResNet50 trained on our dataset on each chunk
4. Count animals presence
5. Generate table

Verify and sign generated table on expert-user side

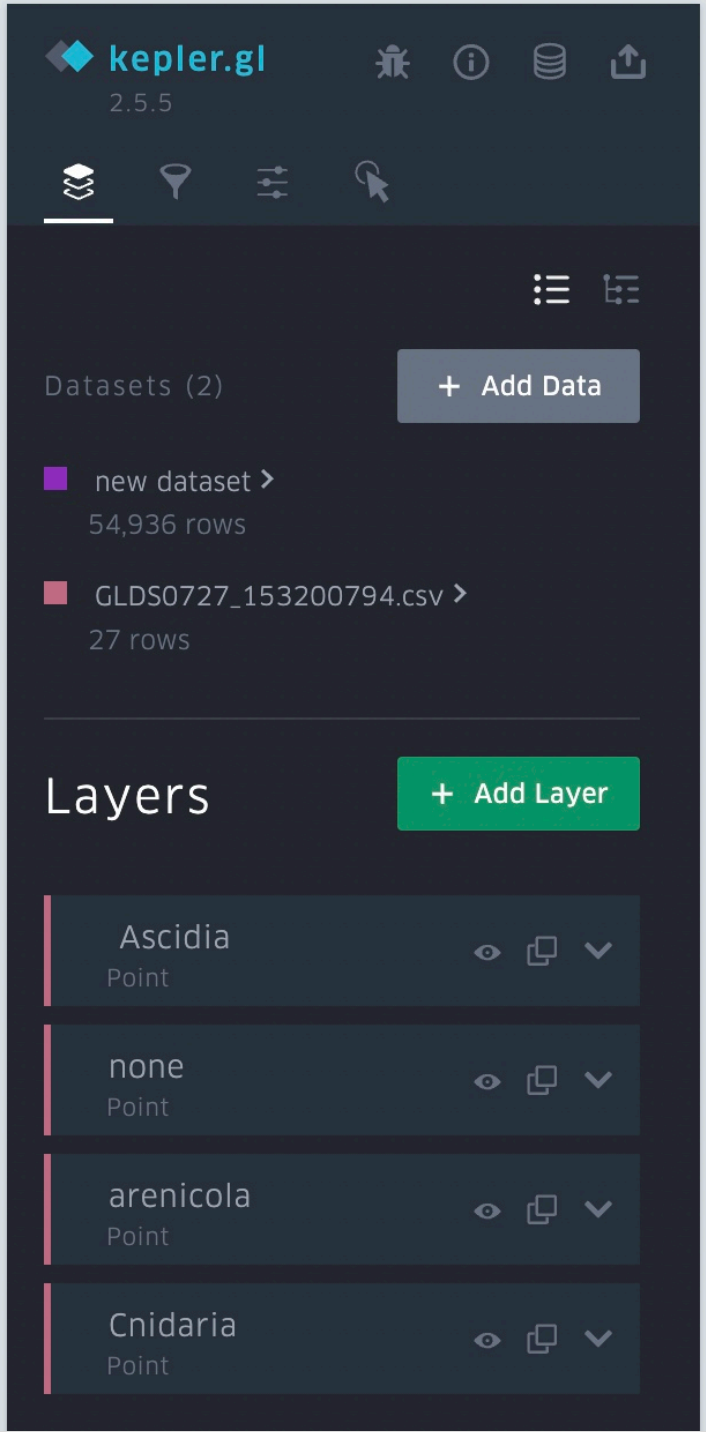
Our solution deployment – WASM

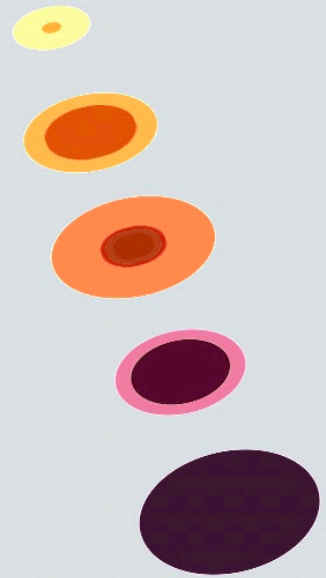
1. Prototype – python, Collaboratory
2. WASM compiled – Runs in a user Web Browser

- FFmpeg (WASM compiled)
- Piodite (bundled with OpenCV) detecting blurry images, cutting chunks
- Onnx-runtime (PyTorch Resnet compiled and deployed in WASM thru it)
- Exceljs (results table generation)

St Petersburg University

Current work in progress





BIO GEO HAB

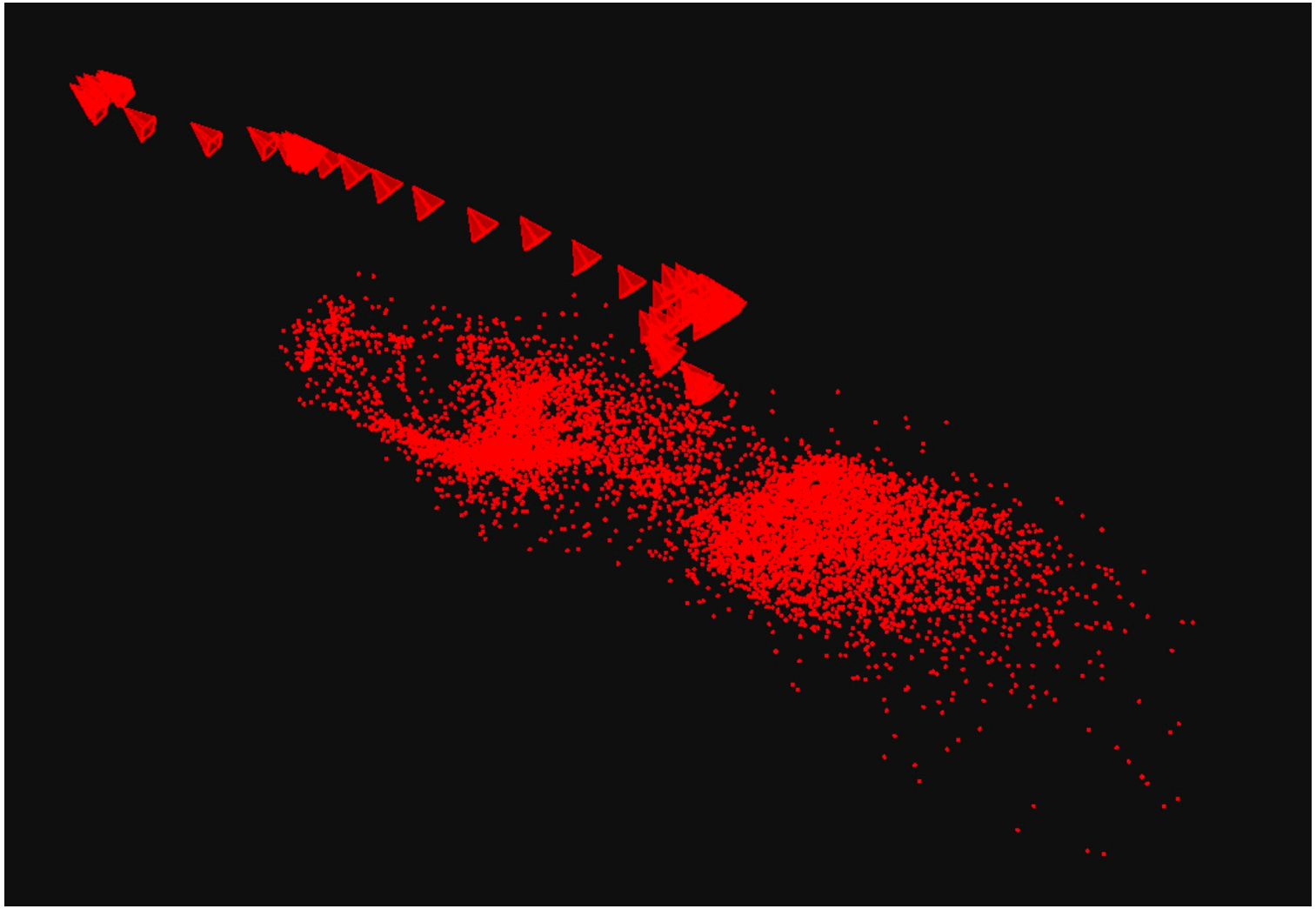
How to count animals correctly and estimate volume? (part 1)

- FSL on a creature type
  - 5 class images required
  - ResNet detection helps to estimate where to apply FSL

BIO GEO HAB

How to count animals correctly and estimate volume? (part 2)

- Video SLAM (HLOC)
- SfM (SPSR)
- Segmentation Projection
- Relative volume estimation



St Petersburg University

Future is so interesting!