

**Impact of Disturbance on Habitat  
Recovery in Habitat Management  
Areas on the Northern Edge of  
Georges Bank**

**Ecosystem Perturbation  
Experiment**

**Woods Hole Oceanographic Institution  
Scott Gallager, Steve Lerner, Mike Saminsky**

**Fishing Community**

**Lund's Fisheries: Wayne Reichle, Jeff Kaelin,  
Captain Brady of the F/V Jersey Cape**

**Scallop Plan Development Team August 28, 2017**

**2016 Scallop Research Set-Aside**

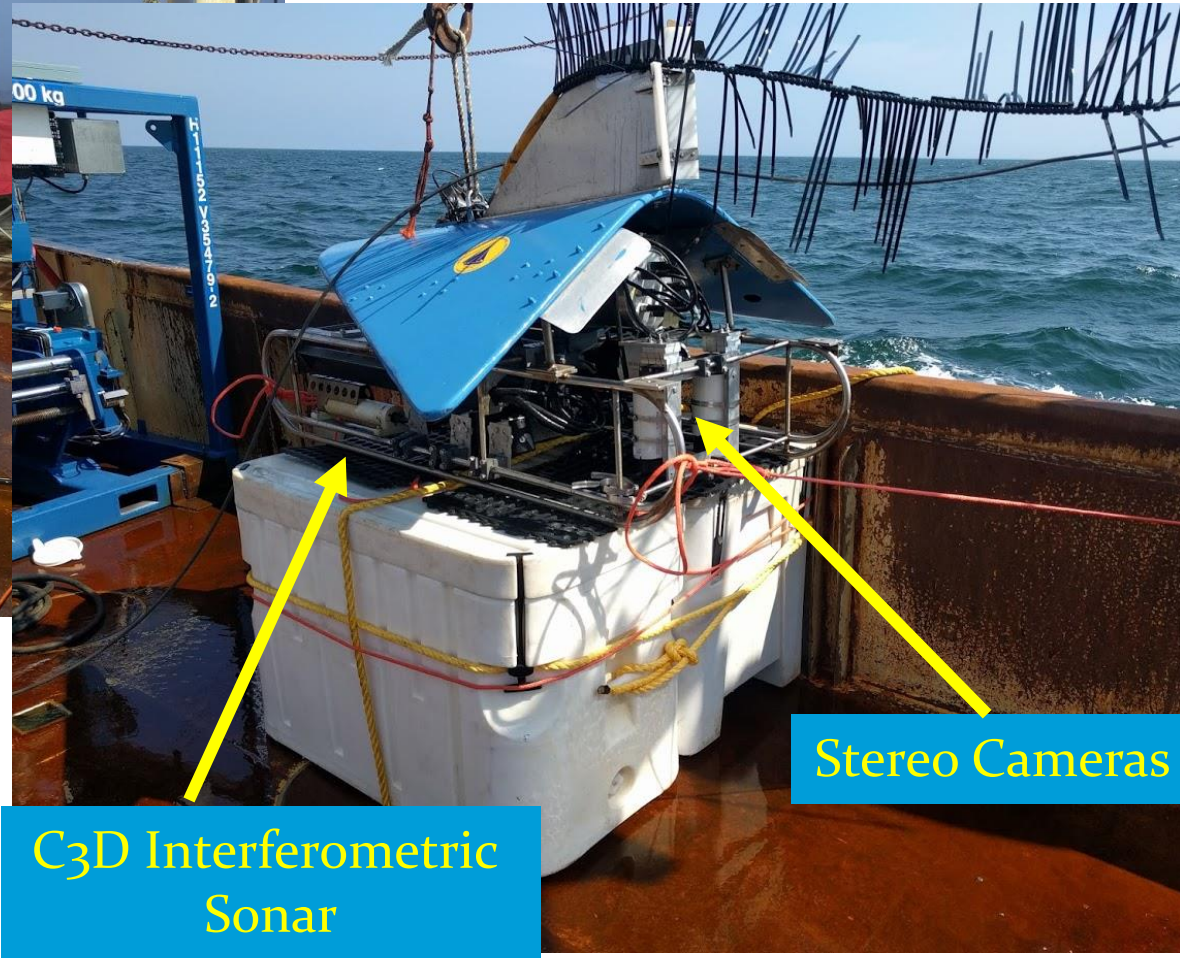
**NOAA-NMFS-NEFSC-2016-2004548**



# HabCamV5 V-fin



Plankton Image Microscope  
CTD, Chloro, Turb, PAR



C<sub>3</sub>D Interferometric  
Sonar

Stereo Cameras

# Habitat Aware Reconnaissance and Imaging Module (HARIM)

## Specifications

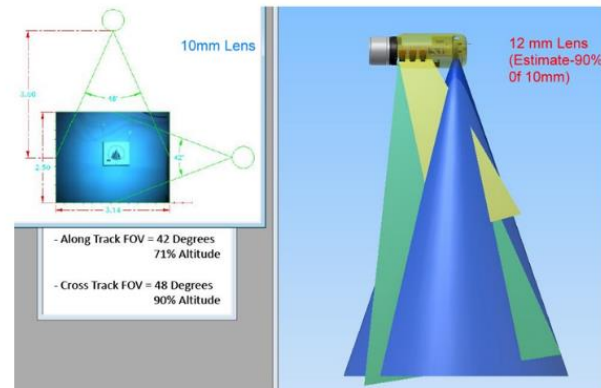
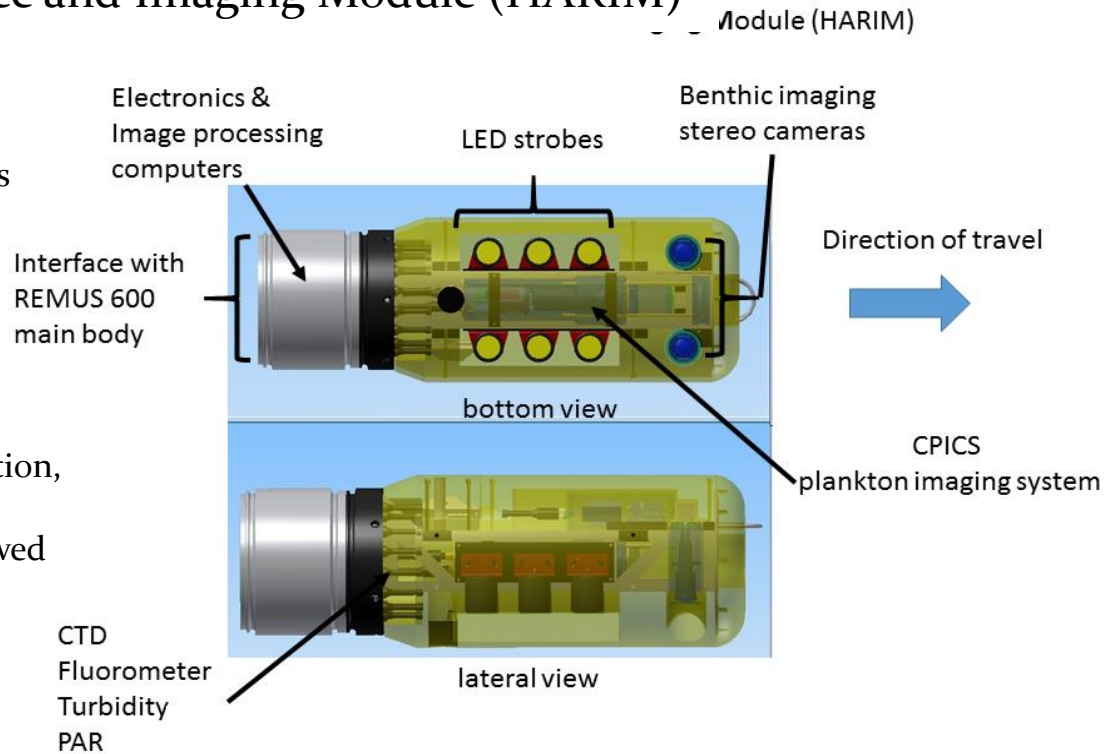
- Vehicle: REMUS 600

## Sensors

- Stereo PT Grey 10 Mpixel cameras, 12mm lenses
- TX2 6 core processor
- CTD, Chlorophyll, turbidity
- Sidescan
- Plankton imaging and classification (CPICS)

## Capabilities

- On-board stereo imaging, light-field and color correction, rectification, point cloud production, and target segmentation
- Benthic target acquisition using sidescan followed by classification using stereo imaging
- On-board plankton classification
- Habitat characterization, spatial analysis, dynamic spatial sampling based on habitat type
- 10 hour deployments up to 600m depth in 3 kt current



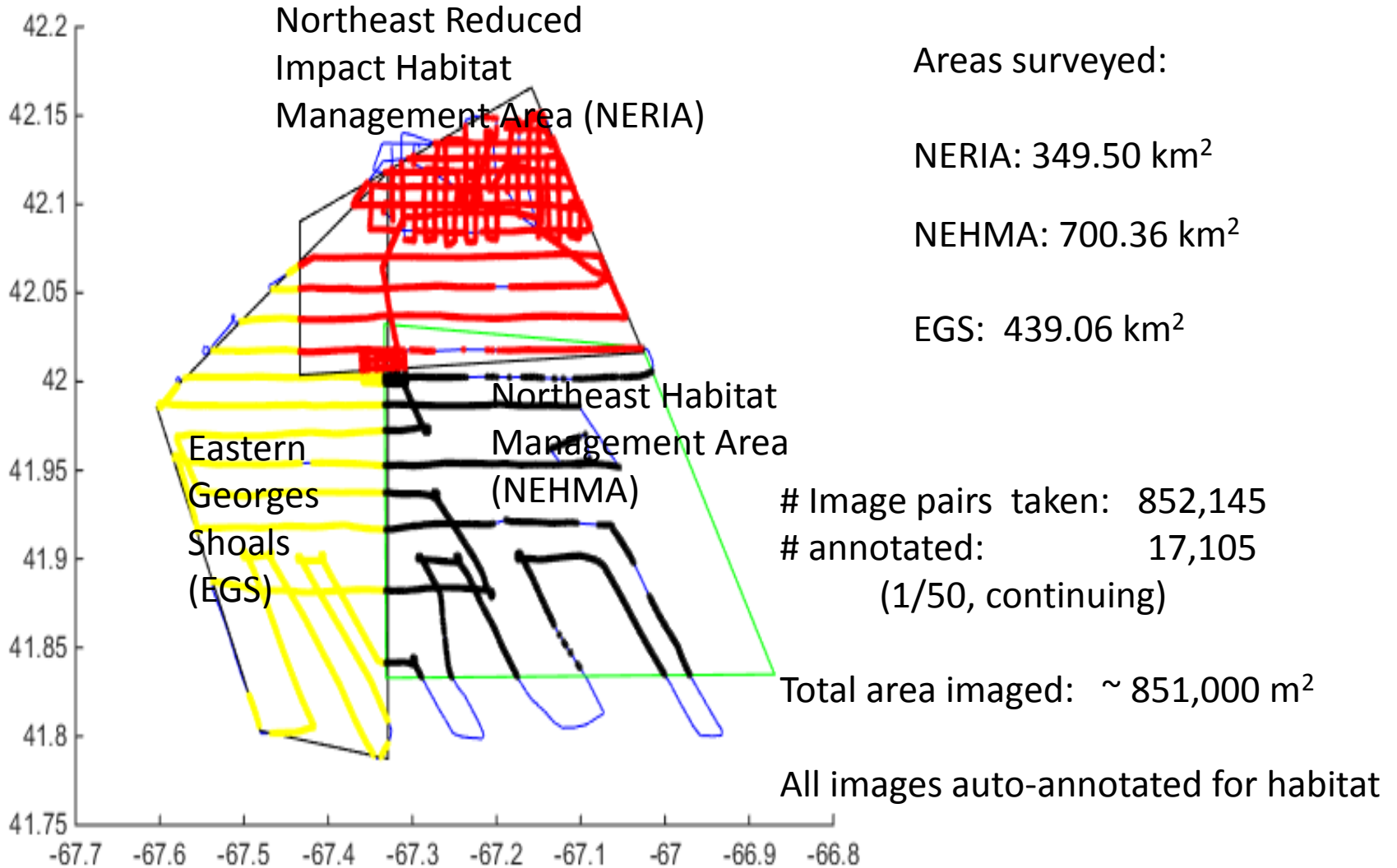
## Objectives of Two Year Study

- 1) To determine the persistence of mechanical impacts of scallop dredging and long-term ecosystem resiliency as a function of substrate type (e.g., sand, sand/gravel, gravel/cobble)
- 2) To complete Before-After Control-Impact (BACI) habitat characterizations at three impact scales (Heavy (5%), Light (0.2%), None (0%)) and three habitat types (sand, sand/gravel/shell, gravel/epifauna) to evaluate ecosystem and habitat resiliency.
- (Metrics for Recovery Rate that relate Impact Intensity and Habitat Type over time will allow for a direct, statistical description of where, at what scale, and how often HMAs could be opened to target high density scallops with minimum impact on sensitive habitat)
- **3) To complete high resolution survey of scallop abundance in the CLA II HMAs to provide information to the Council as to where targeted scallop fishing might be allowed on a limited basis while concurrently mitigating impact on habitat.**
- (New Habitat Characterization Module for the REMUS 600 Autonomous Underwater Vehicle (AUV) with very high resolution (mm scale) stereo imagery and a sidescan unit (cm to 100m scale)

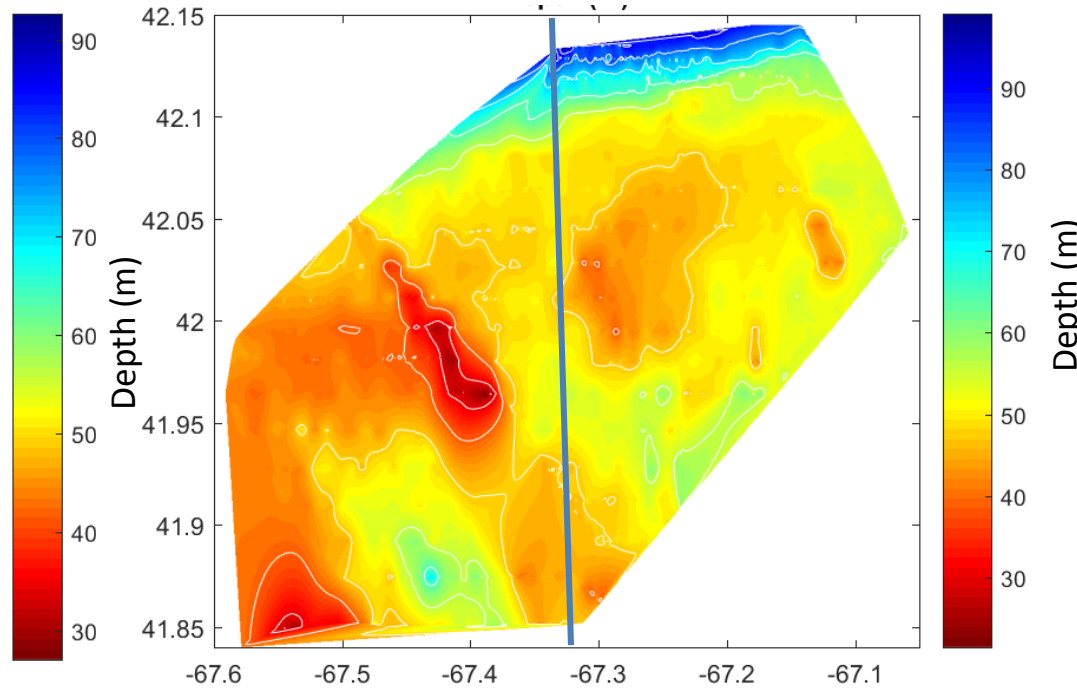
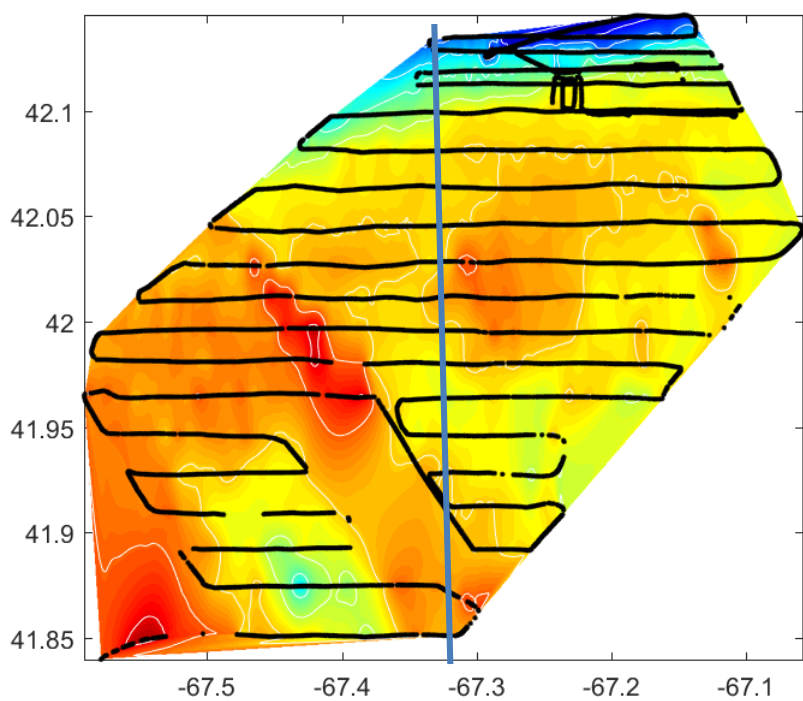




# 2017 RSA Survey HabCamV5



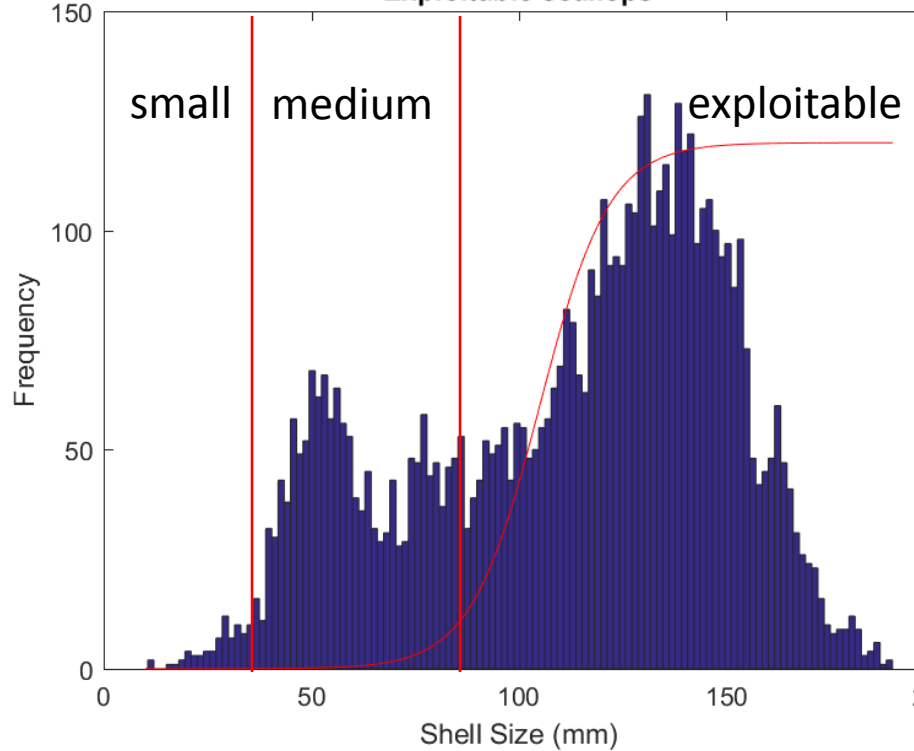
### Bathymetry



Highest # scallops / image: 39  
Number of annotators: 7



Size Frequency All Areas



Exploitable shell heights based on Dupaul, 2008

$a = -12.6$

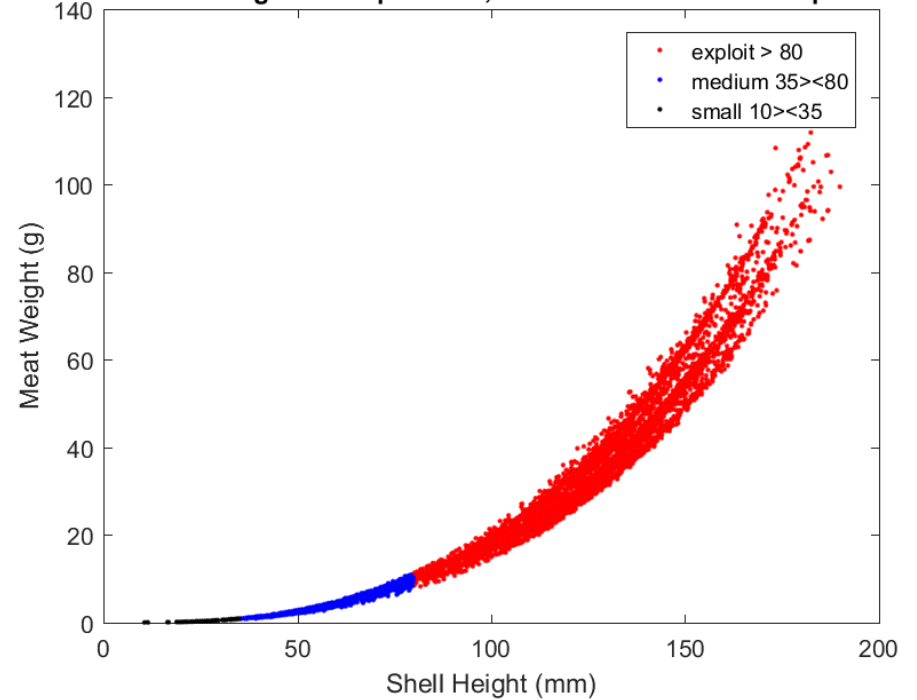
$b = 0.12$

$sh\_bin = linspace(10,200,length(lengths));$

$r = \exp(a+b * sh\_bin)./(1+\exp(a+b * sh\_bin));$

$exploit\_num = lengths .* r';$

Meat Weight for Exploitable, Medium and Small scallops

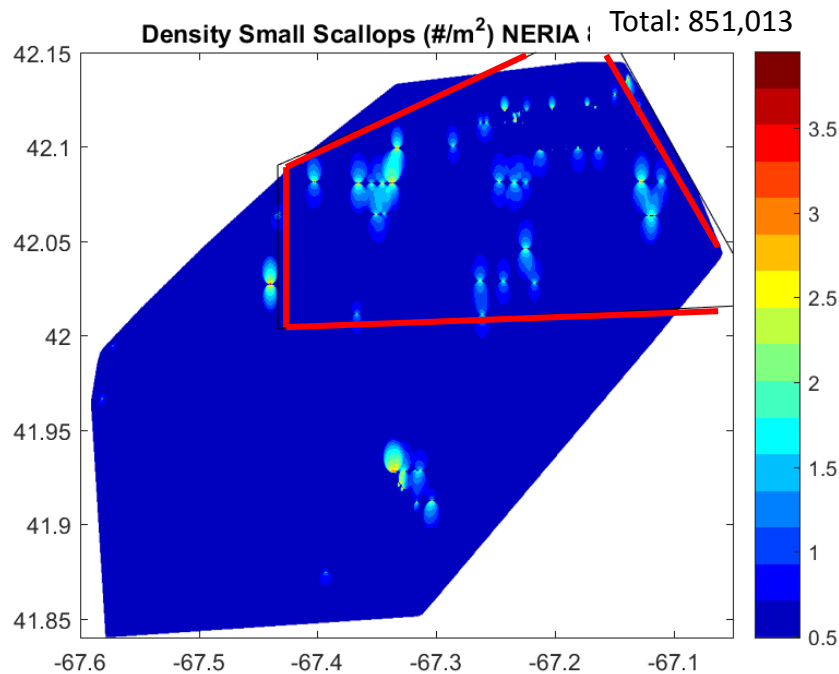
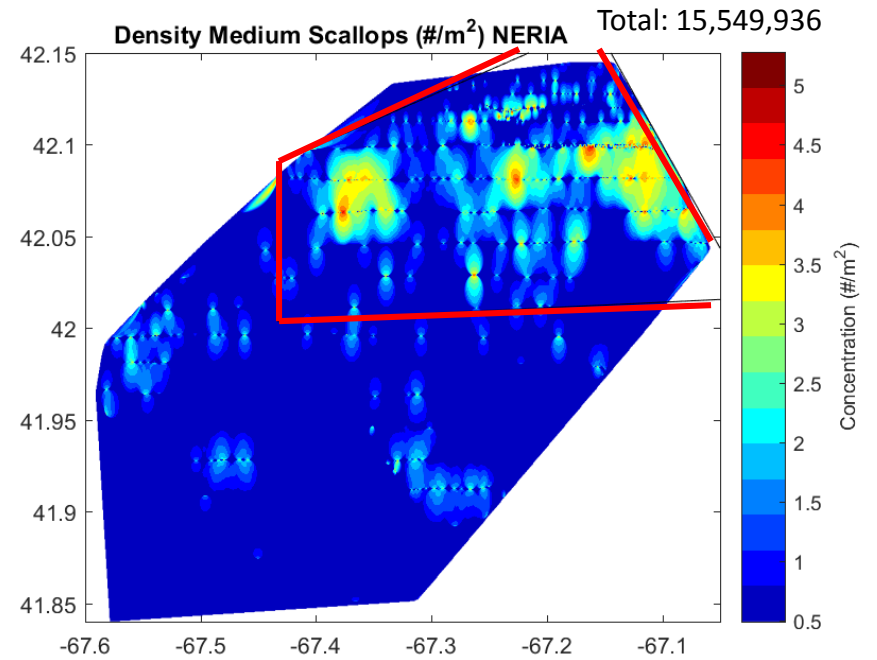
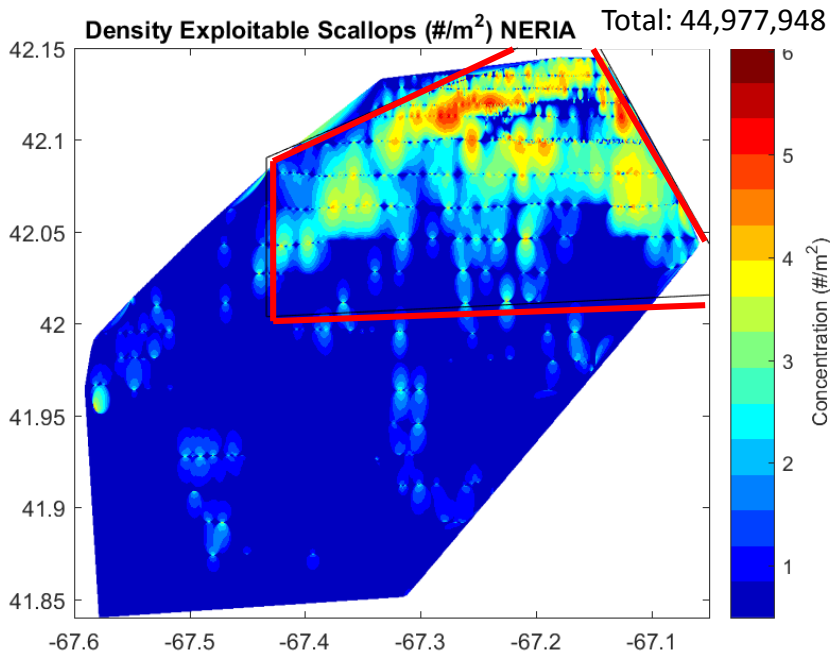


Hennen, D.R. and D.R. Hart. 2012.

JSR 3 (4) 1133-1144

$E(M) = \exp(\alpha + \gamma \ln D + \delta \ln L + \theta u + \beta \ln H + r_1 + r_2 \ln H)$

D: depth, L: latitude, H: Shell Height, u: subarea,  
+ random effects



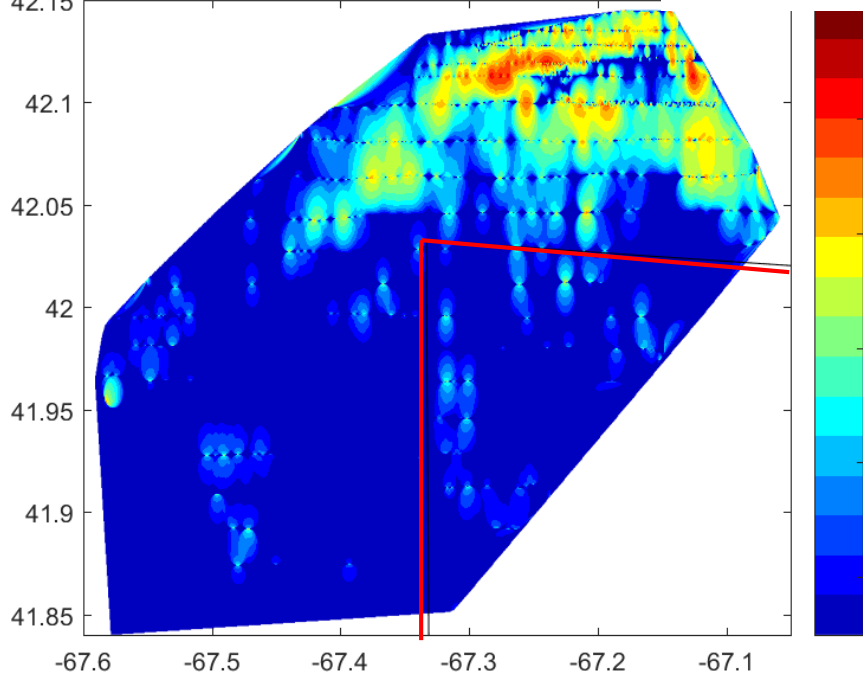
Northeast Reduced  
Impact Habitat  
Management Area  
(NERIA)

Gridded to 30 m squares

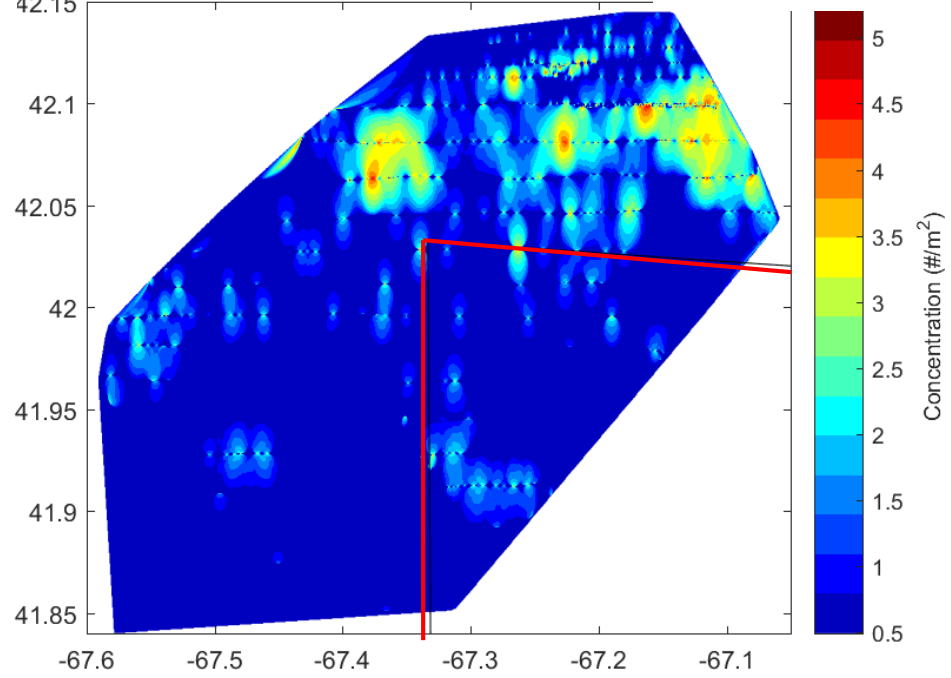
Ordinary Kriging  
with depth as co-variate

Also comparing with  
Empirical Bayesian kriging

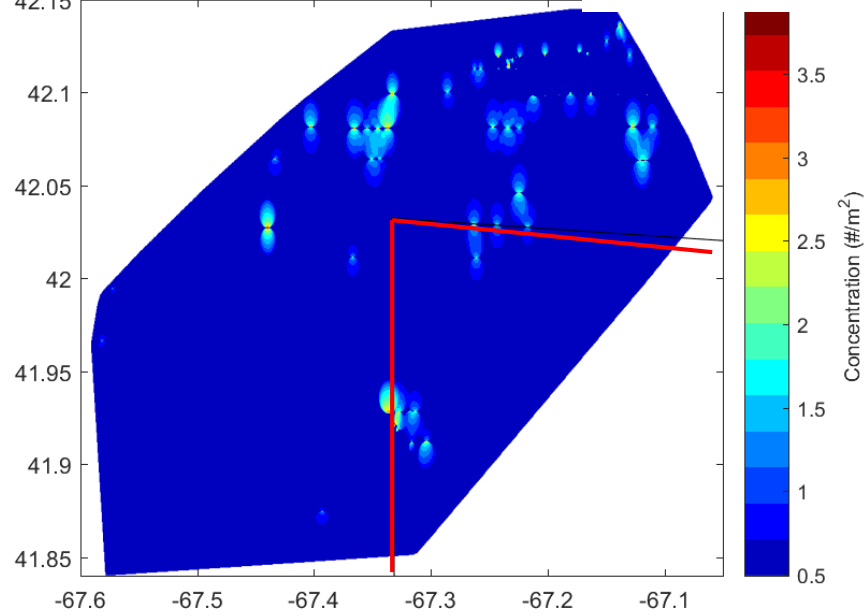
Density Exploitable Scallops (#/m<sup>2</sup>) NEHMA Total: 1,260,245



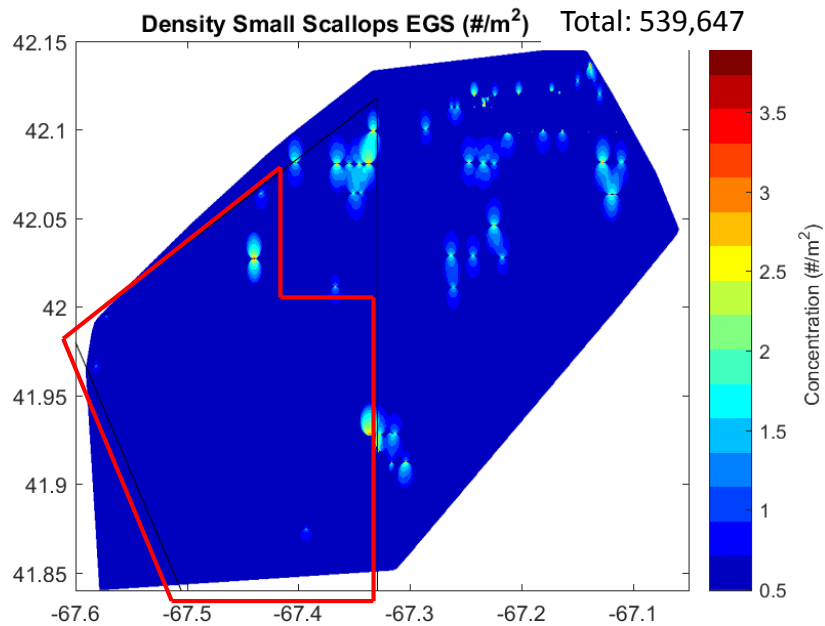
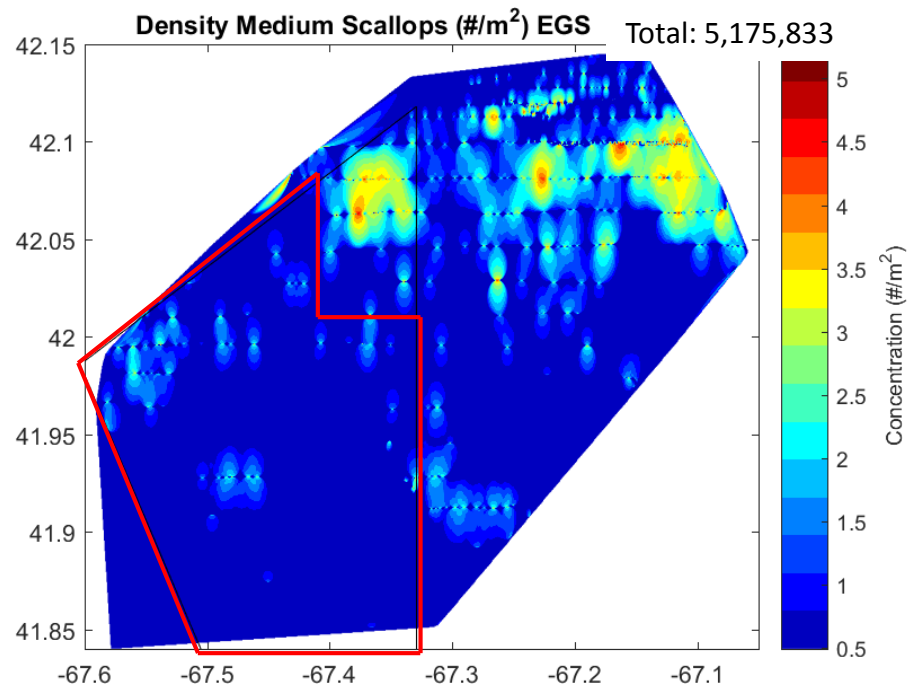
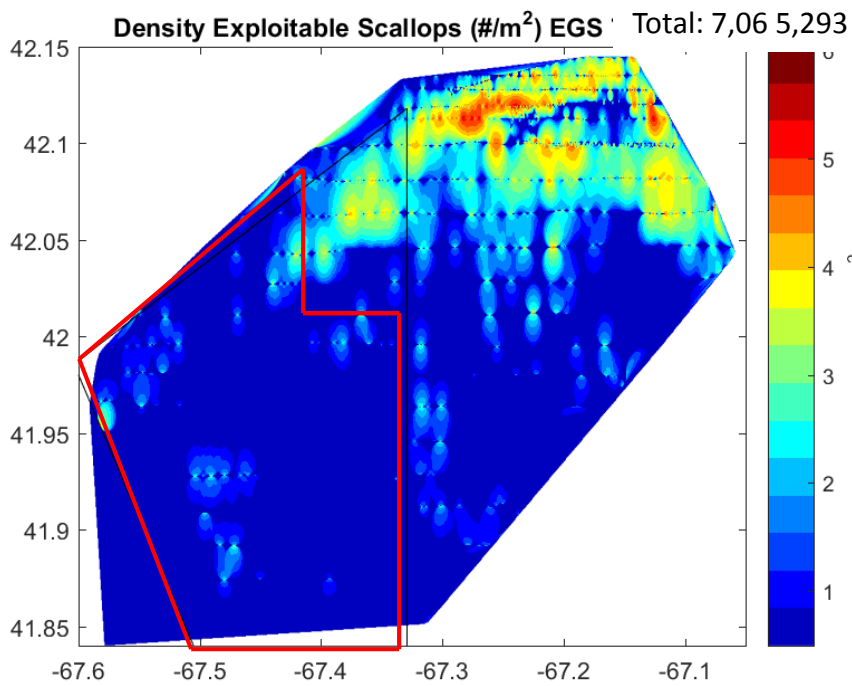
Density Medium Scallops (#/m<sup>2</sup>) NEHMA Total: 1,029,840



Density Small Scallops NEHMA (#/m<sup>2</sup>) Total: 184,850

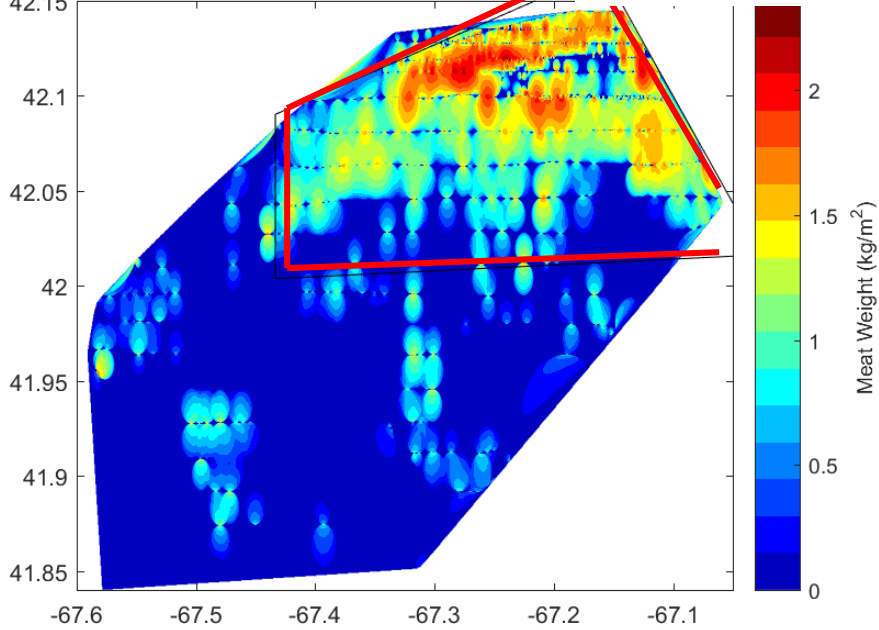


Northeast Habitat  
Management Area  
(NEHMA)

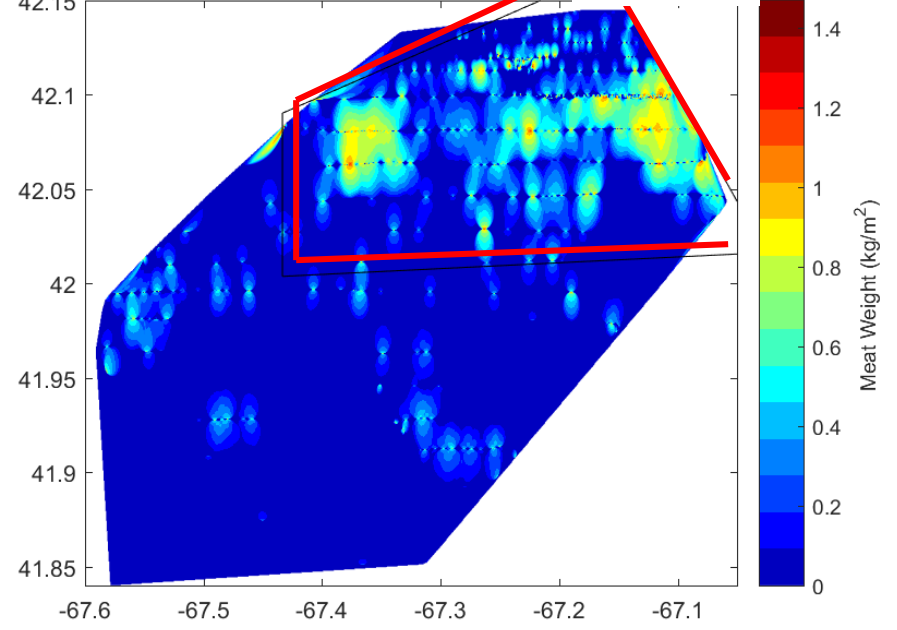


Eastern Georges  
Shoals  
(EGS)

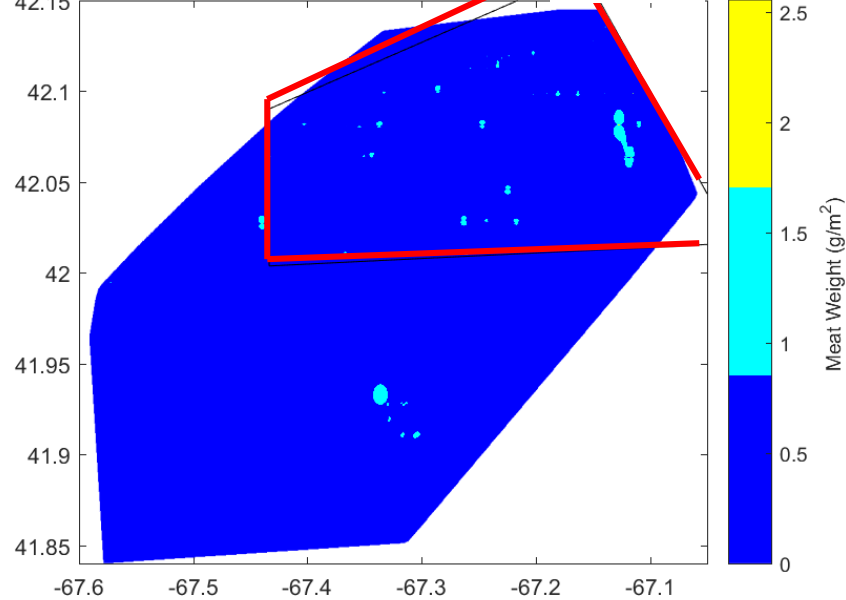
**Meat Weight Exploitable Scallops NERIA 13,158.13 MT**



**Meat Weight Medium Scallops NERIA 493.36 MT**



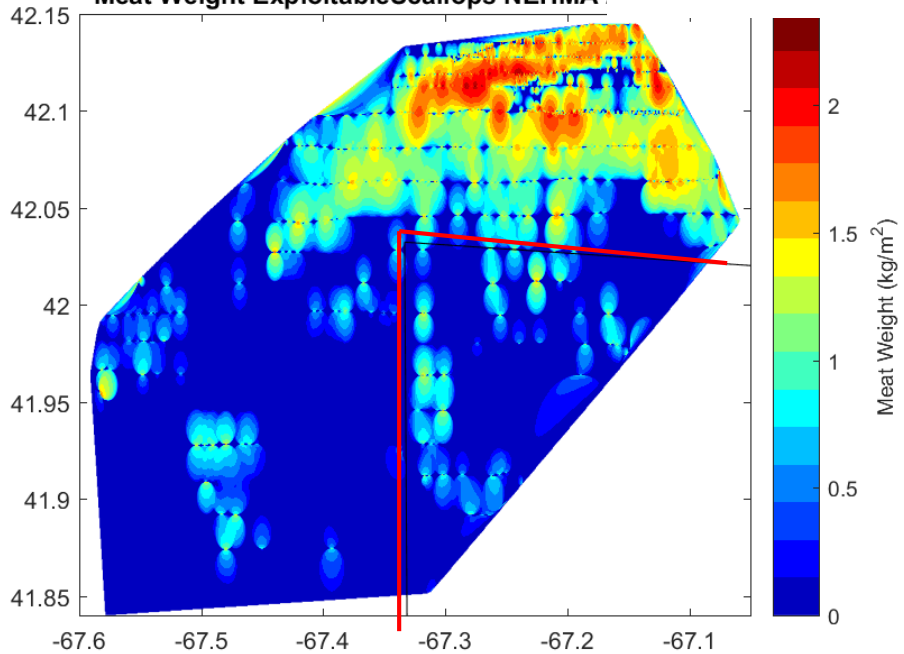
**Meat Weight Small Scallops NERIA 1.49 MT**



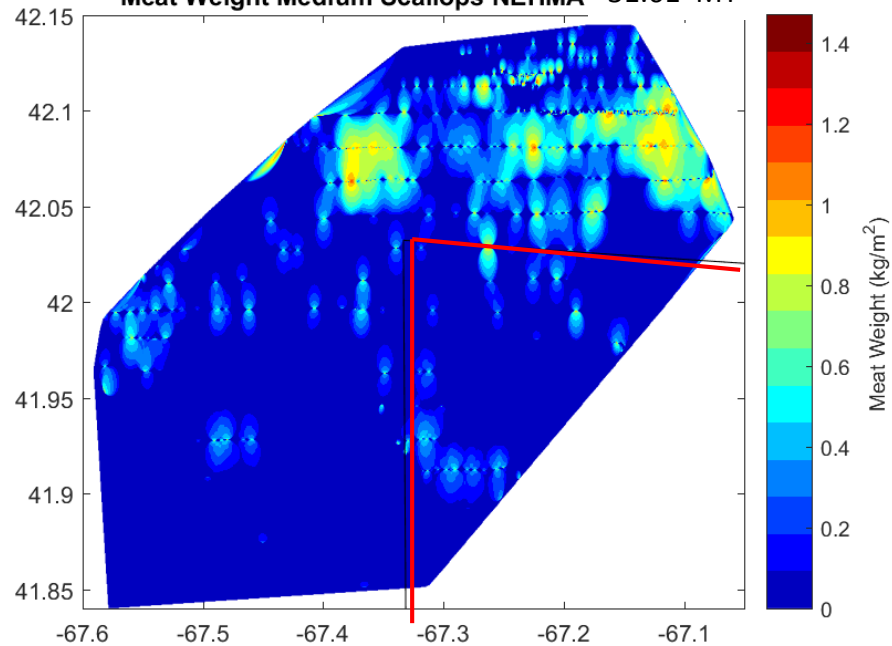
Biomass

Northeast Reduced  
Impact Habitat  
Management Area  
(NERIA)

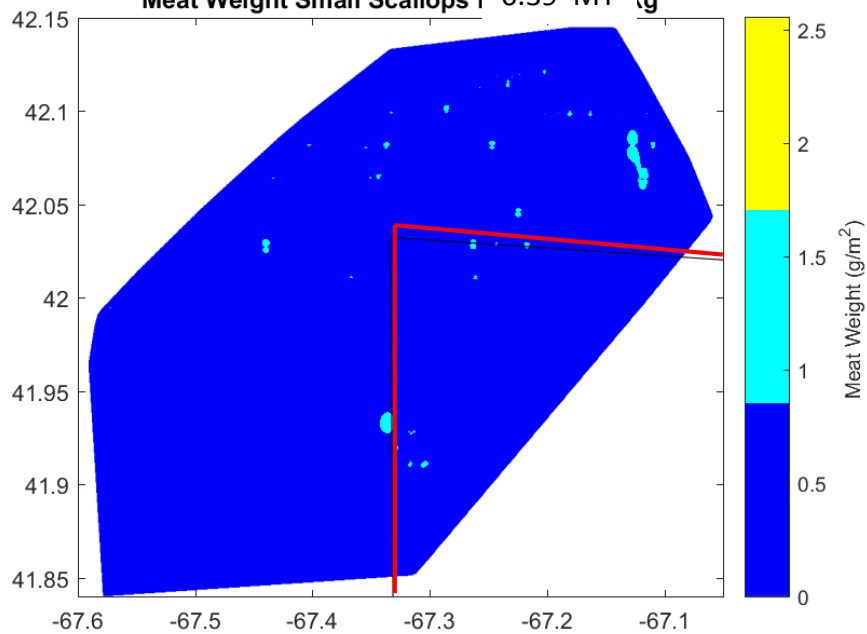
**Meat Weight Exploitable Scallops NEHMA 299.06 MT**



**Meat Weight Medium Scallops NEHMA 31.61 MT**



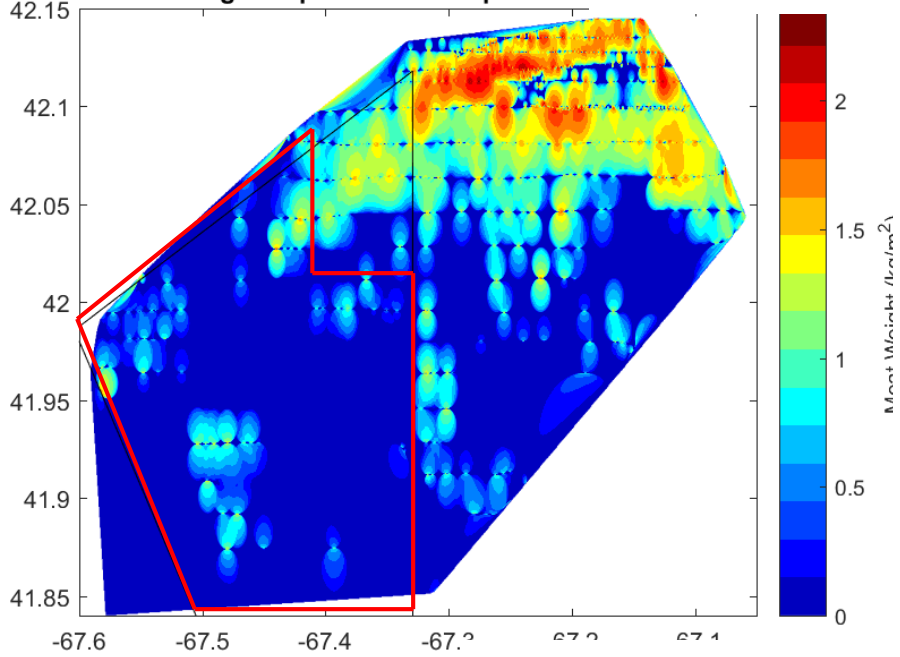
**Meat Weight Small Scallops I 0.39 MT cg**



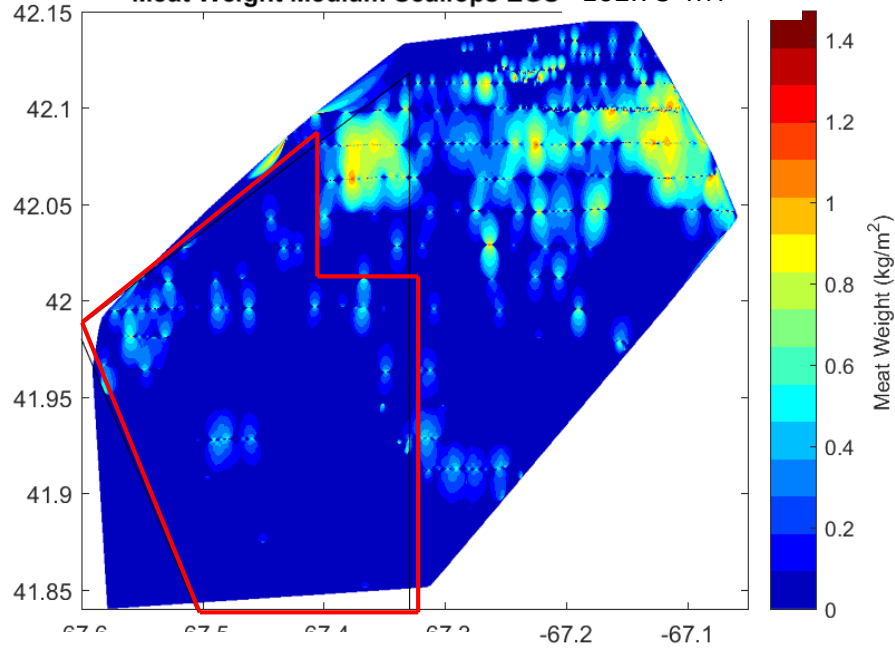
Biomass

Northeast Habitat  
Management Area  
(NEHMA)

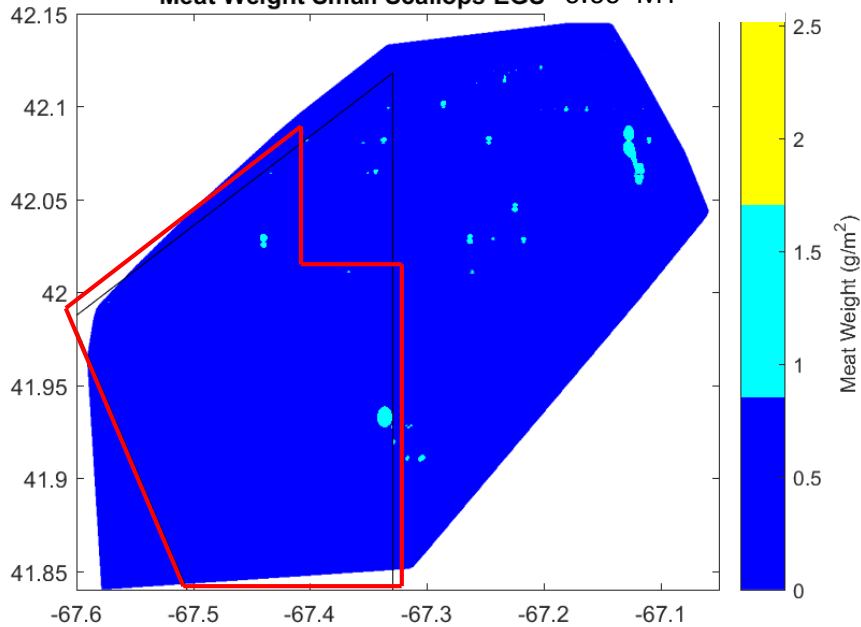
Meat Weight Exploitable Scallops EGS 1,274.10 MT



Meat Weight Medium Scallops EGS 162.78 MT



Meat Weight Small Scallops EGS 0.60 MT

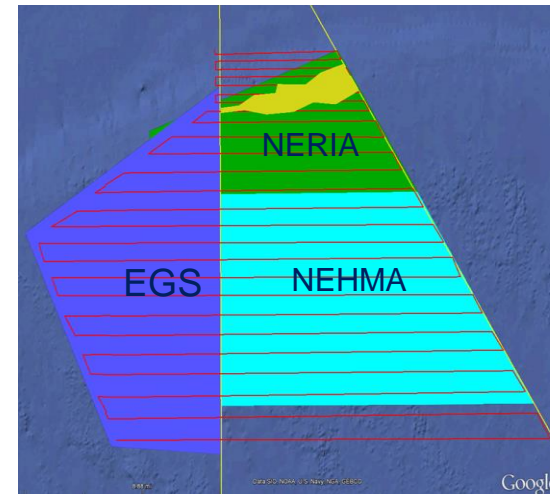


Biomass

Eastern Georges  
Shoals  
(EGS)

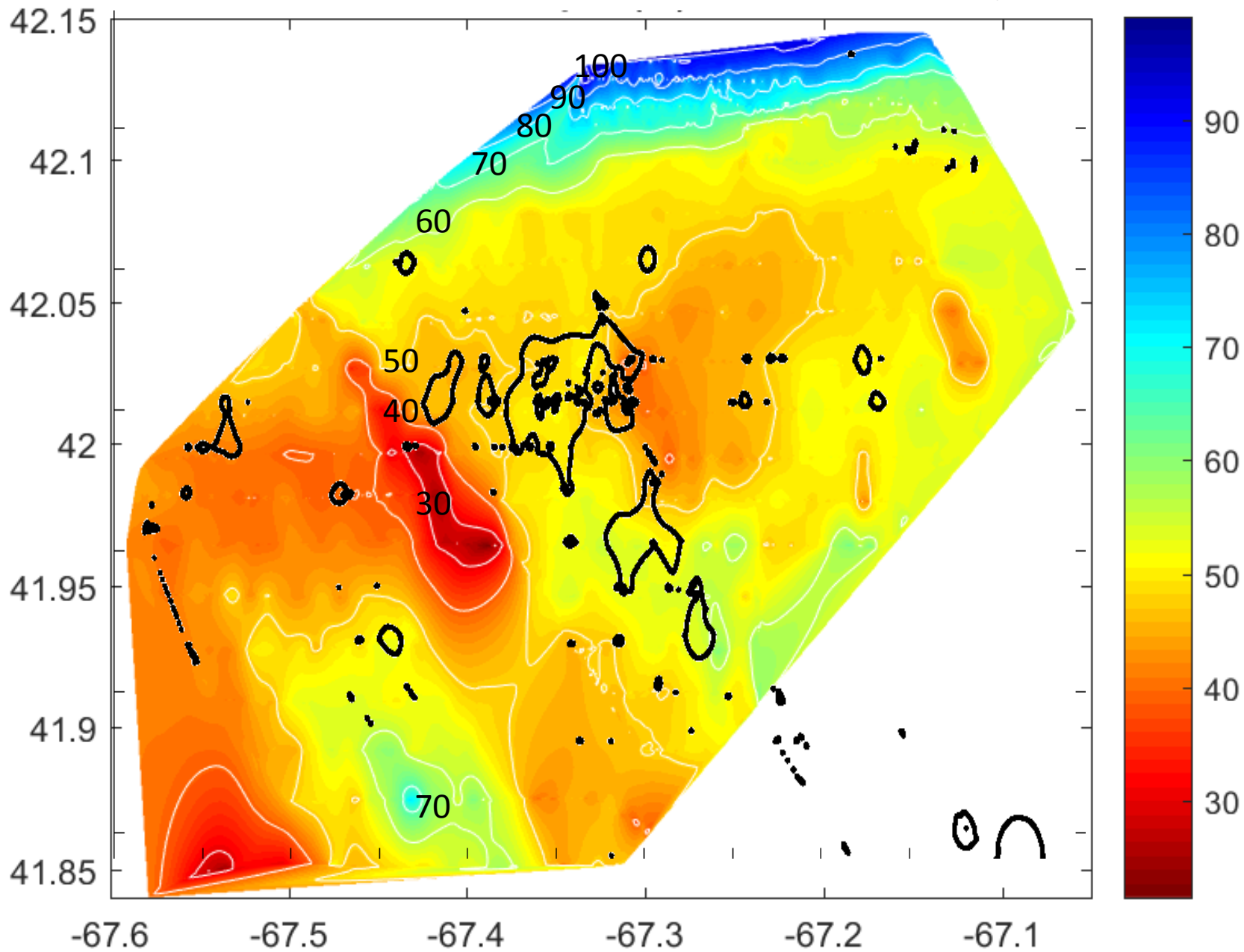
## 2017 Survey July 20-24

	Numbers of Scallops			
	Exploitable	Medium	Small	All Scallops
All Areas	53,303,486	21,755,609	1,575,510	76,634,605
NERIA	44,977,948	15,549,936	851,013	61,378,897
NEHMA	1,260,245	1,029,840	184,850	2,474,935
EGS	7,065,293	5,175,833	539,647	12,780,773
	Biomass of Scallops (MT)			
	Exploitable	Medium	Small	All Scallops
All Areas	14,731.29	687.75	2.49	15,421.53
NERIA	13,158.13	493.36	1.49	13,652.98
NEHMA	299.06	31.61	0.39	331.06
EGS	1,274.10	162.78	0.60	1,437.48

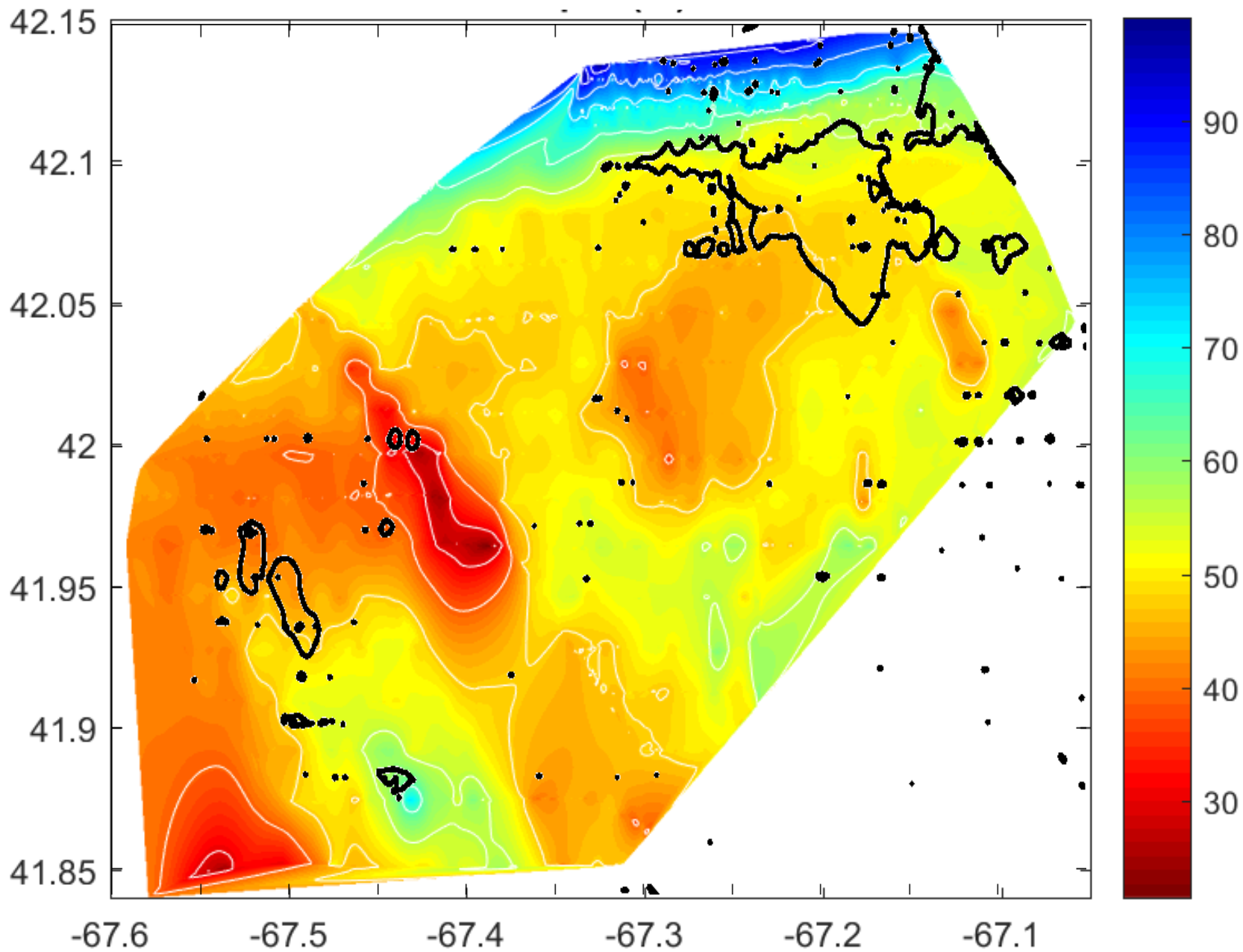




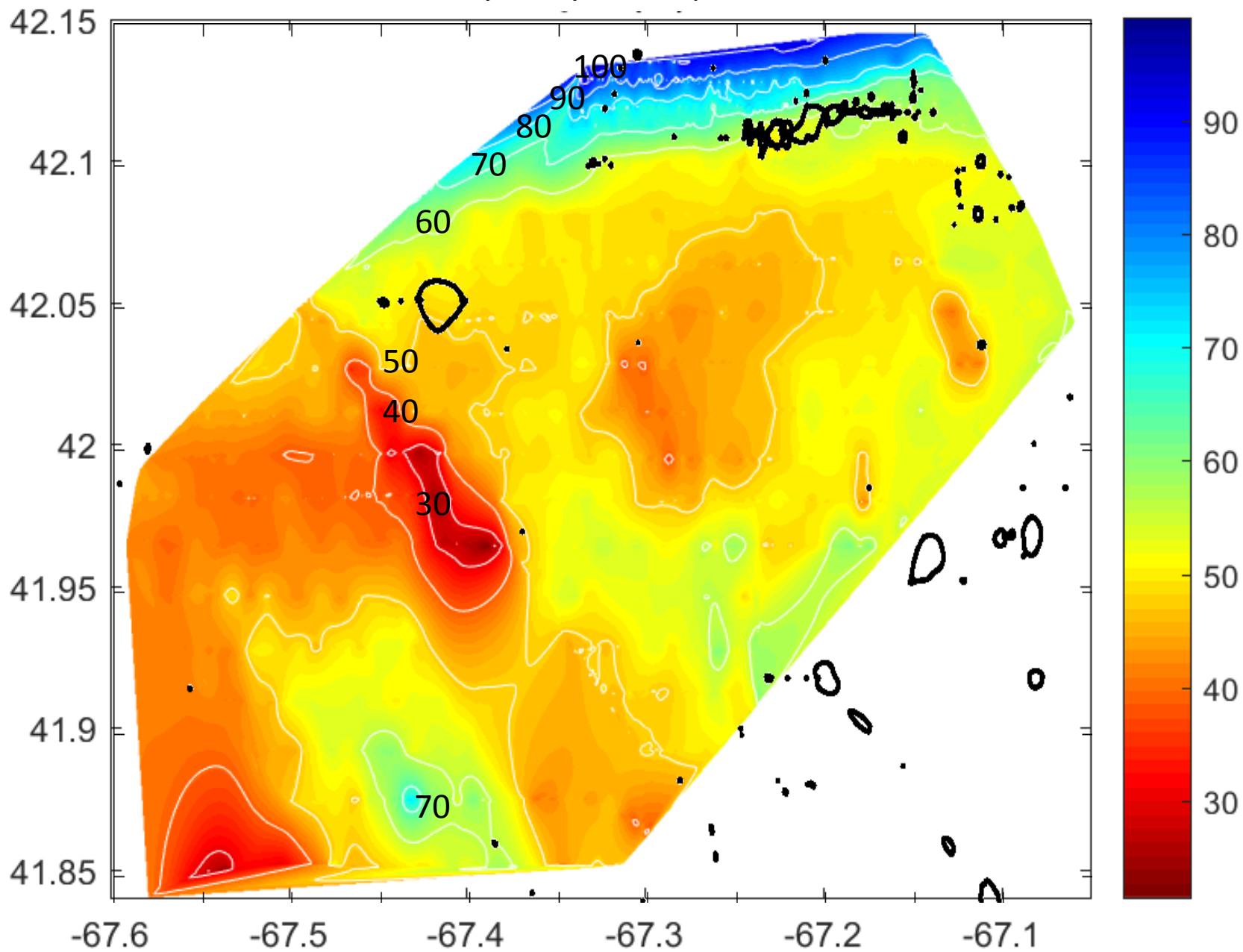
Bathymetry with Gravel Contours



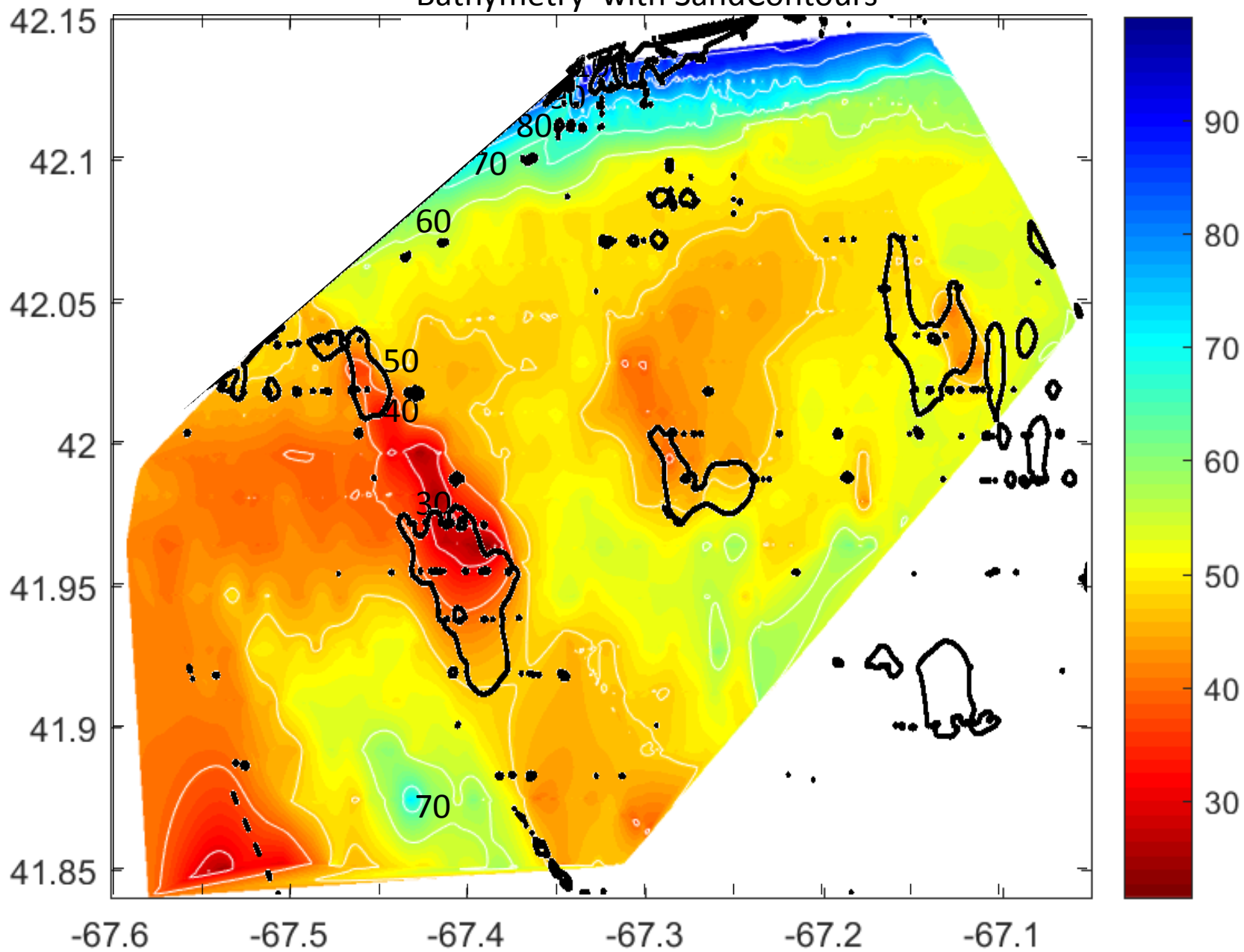
Bathymetry with Shell Hash Contours



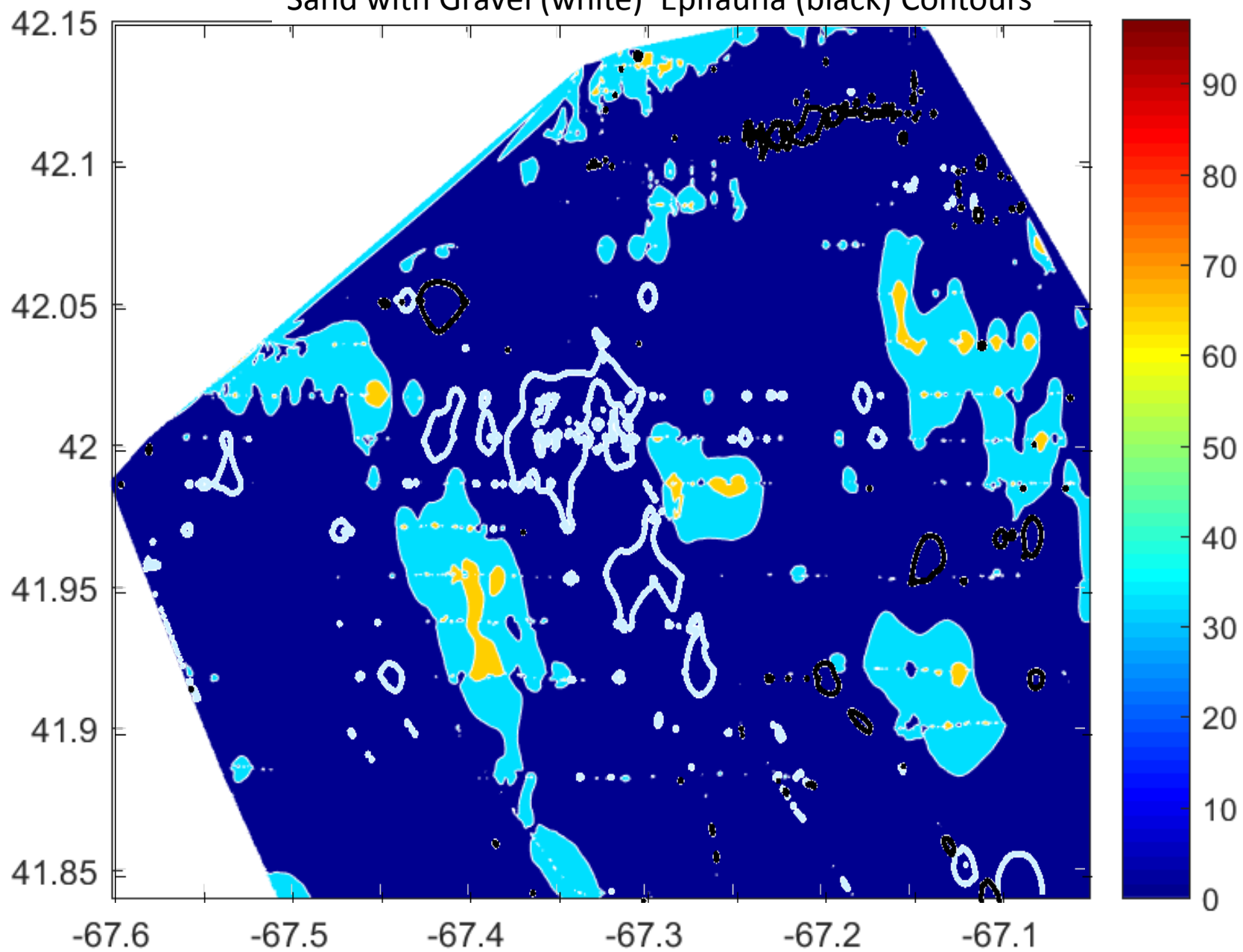
Bathymetry with Epifauna Contours



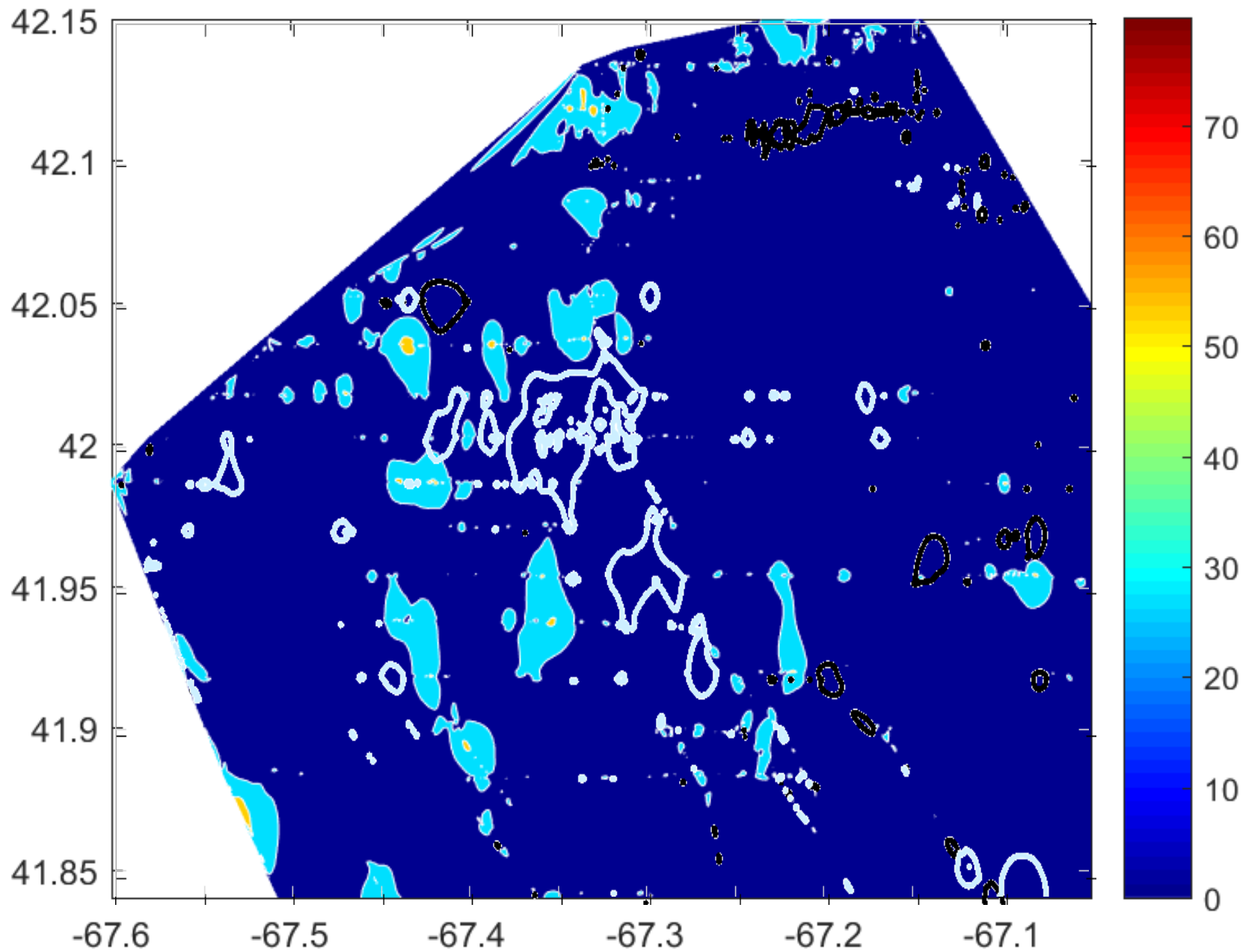
Bathymetry with SandContours



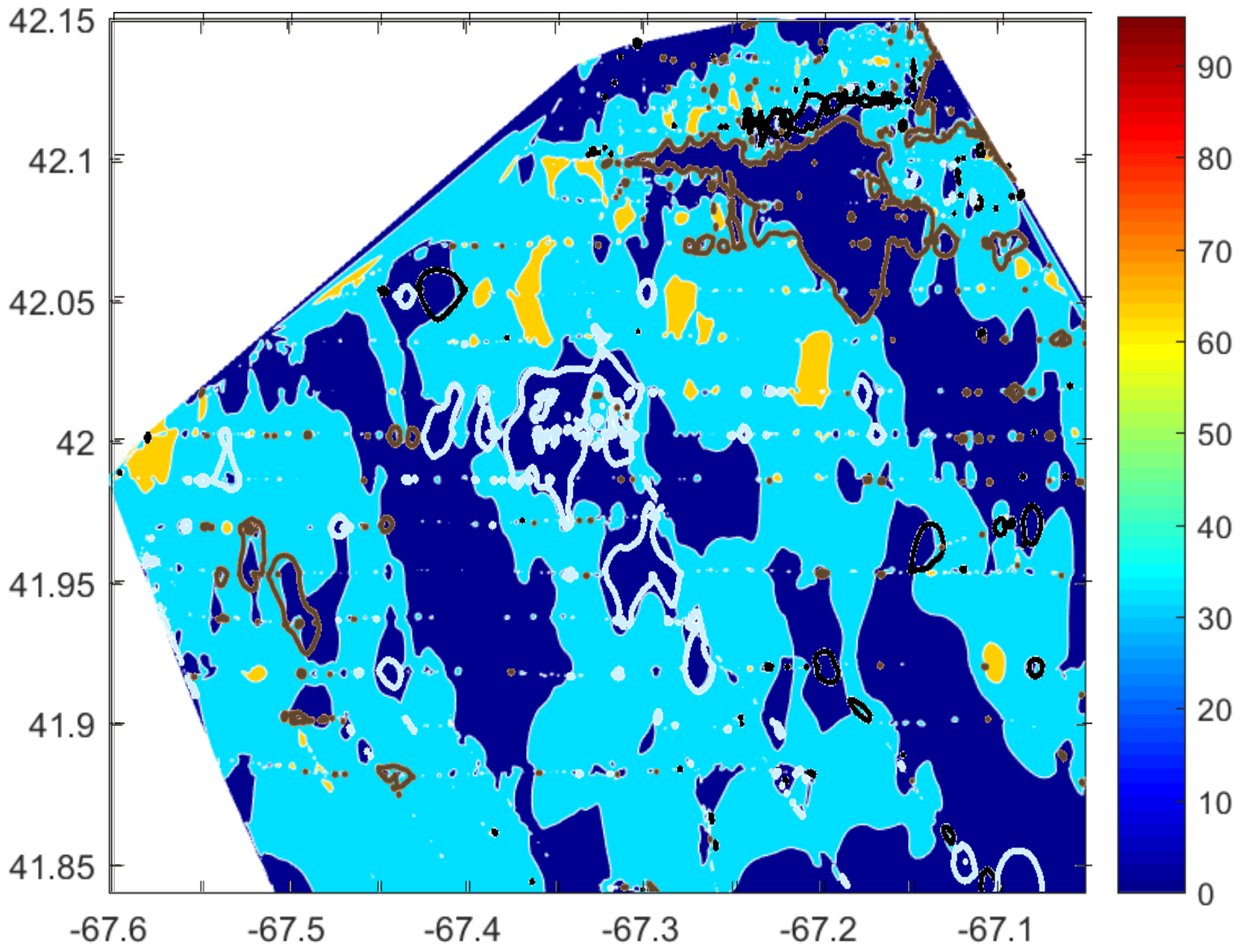
Sand with Gravel (white) Epifauna (black) Contours



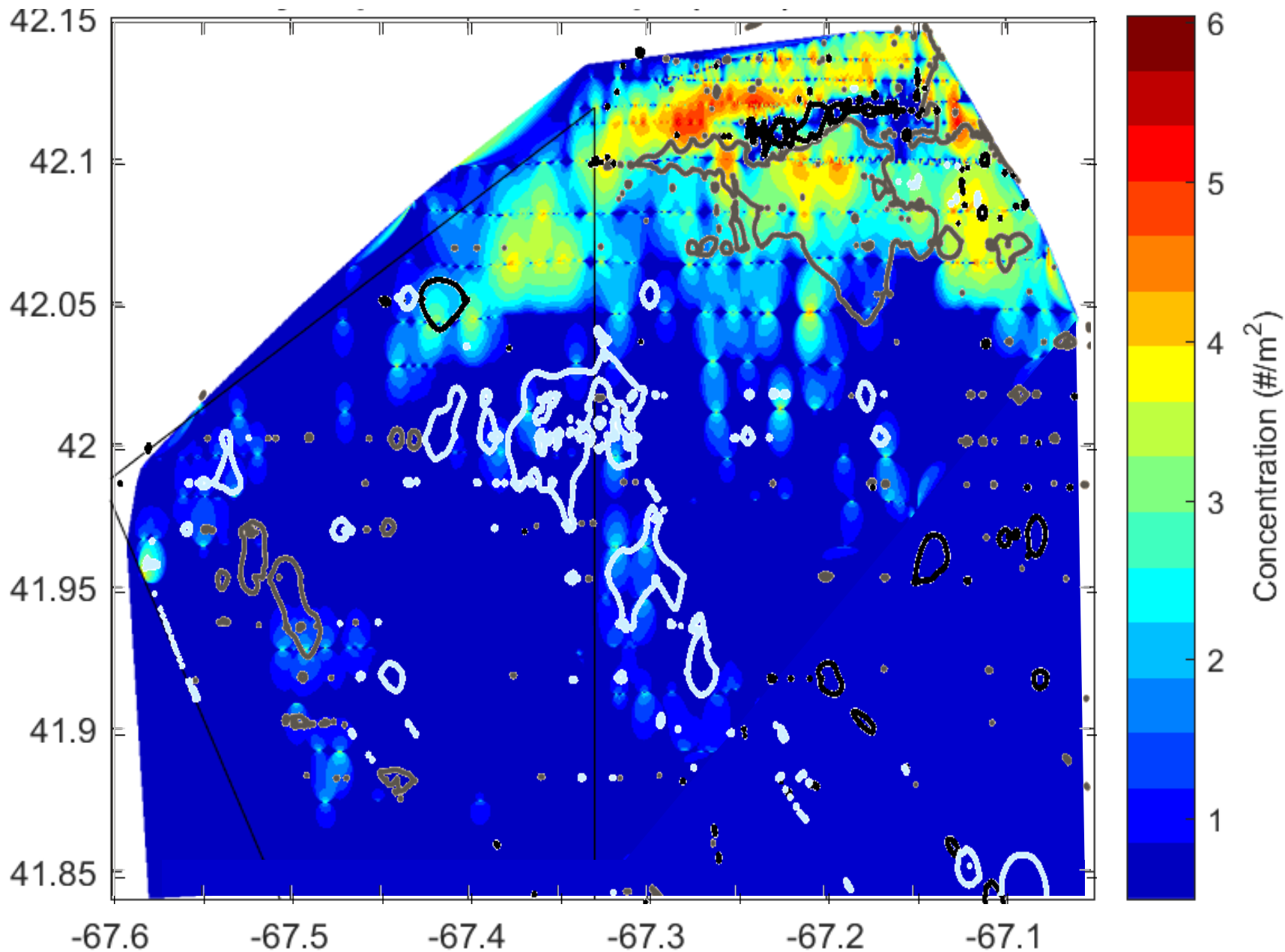
Dark Sand with Gravel (white) Epifauna (black) Contours



Sand / Gravel with Gravel (white) , Epifauna (black) , Shell Hash (brown) Contours

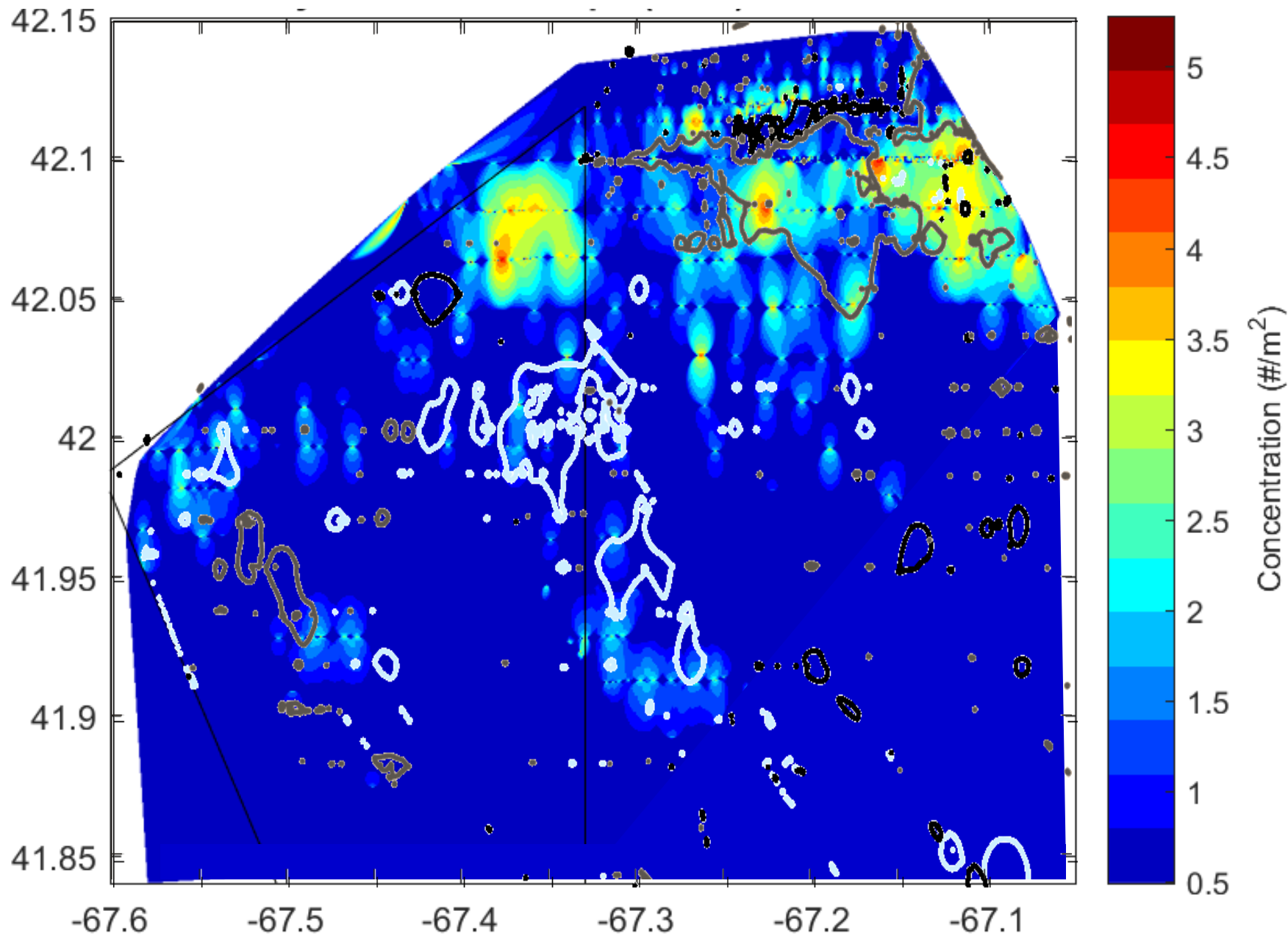


Exploitable Scallops with Gravel (white) , Epifauna (black) , Shell Hash (brown) Contours

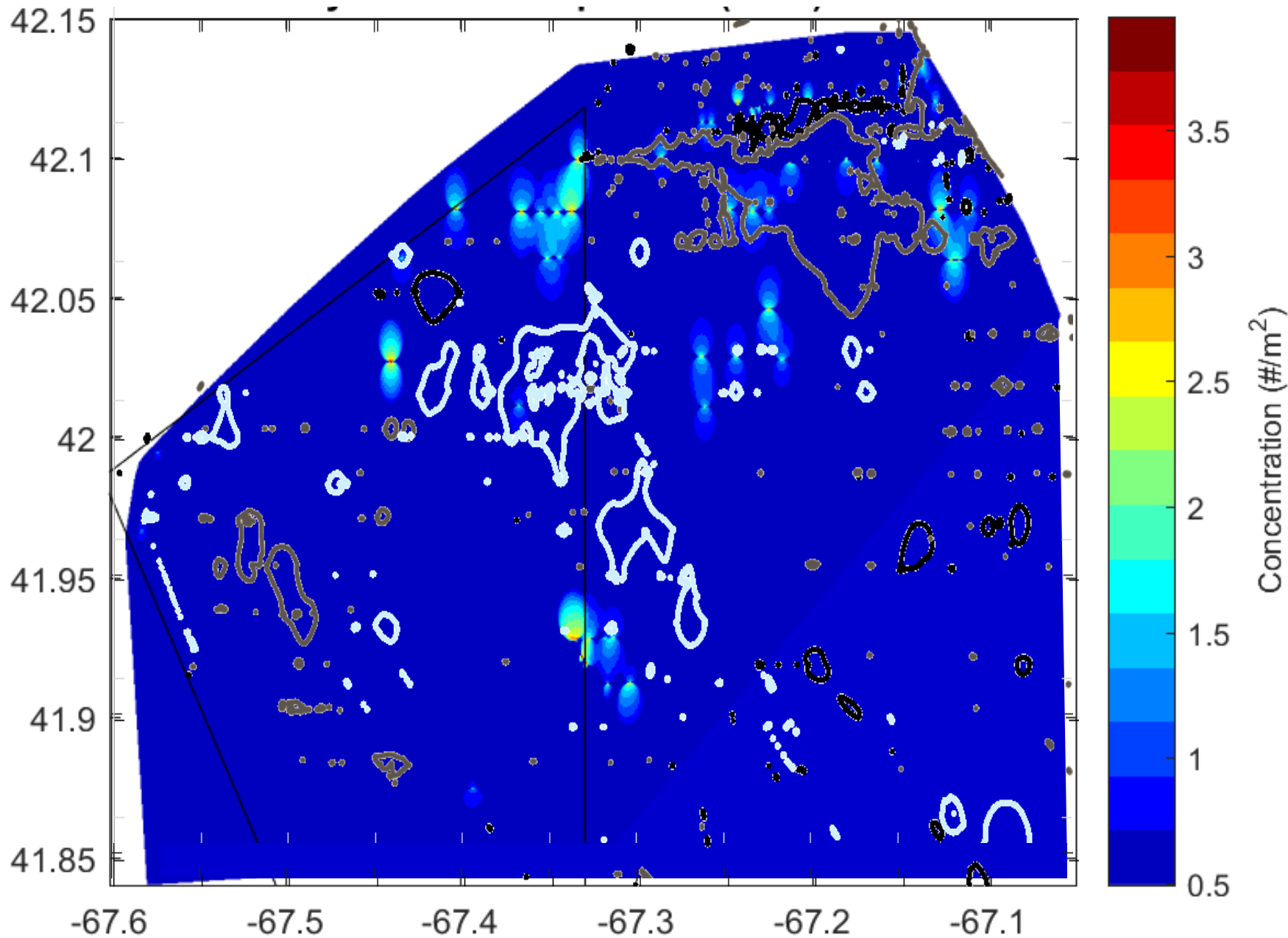




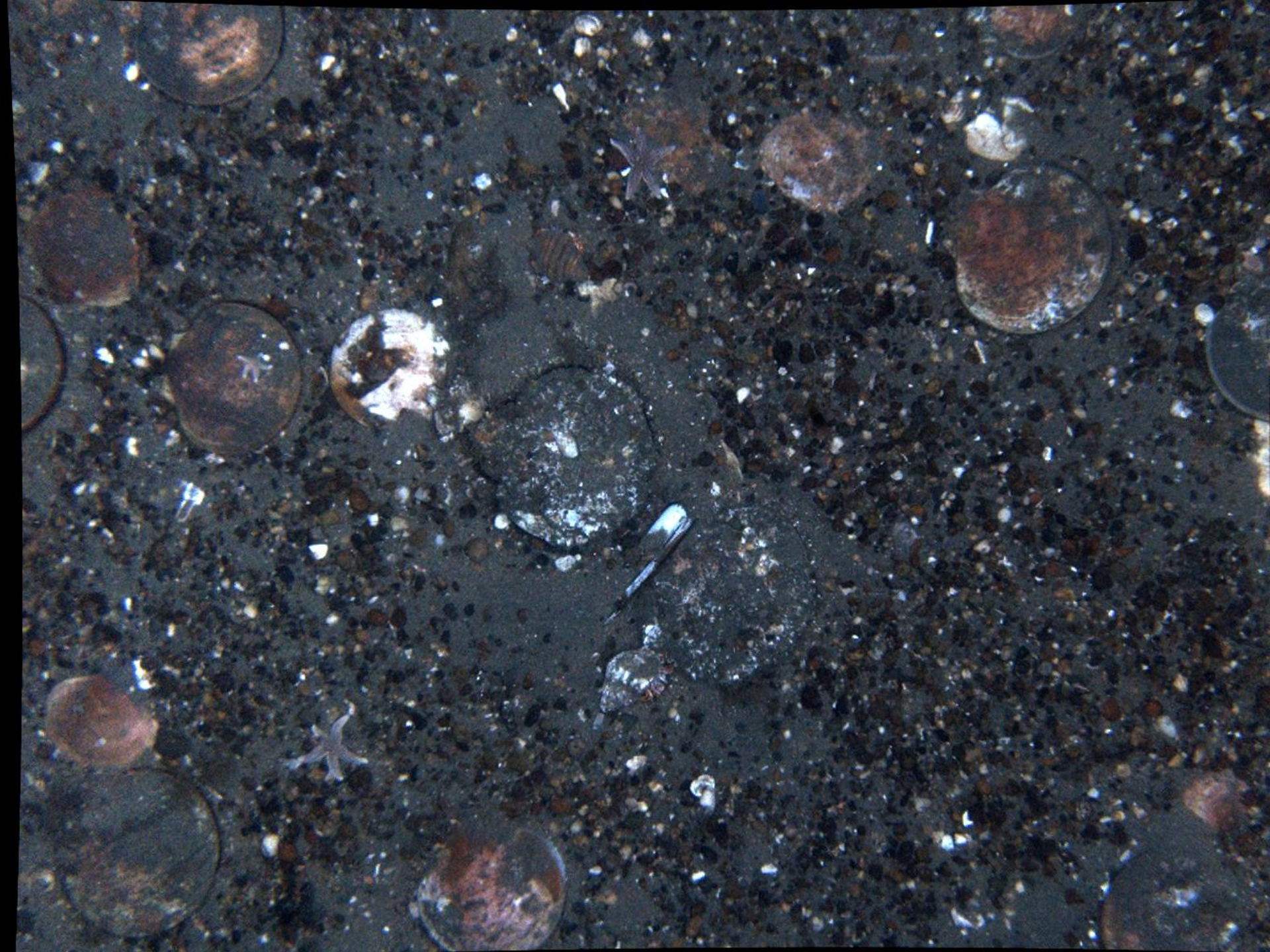
Medium Scallops with Gravel (white) , Epifauna (black) , Shell Hash (brown) Contours

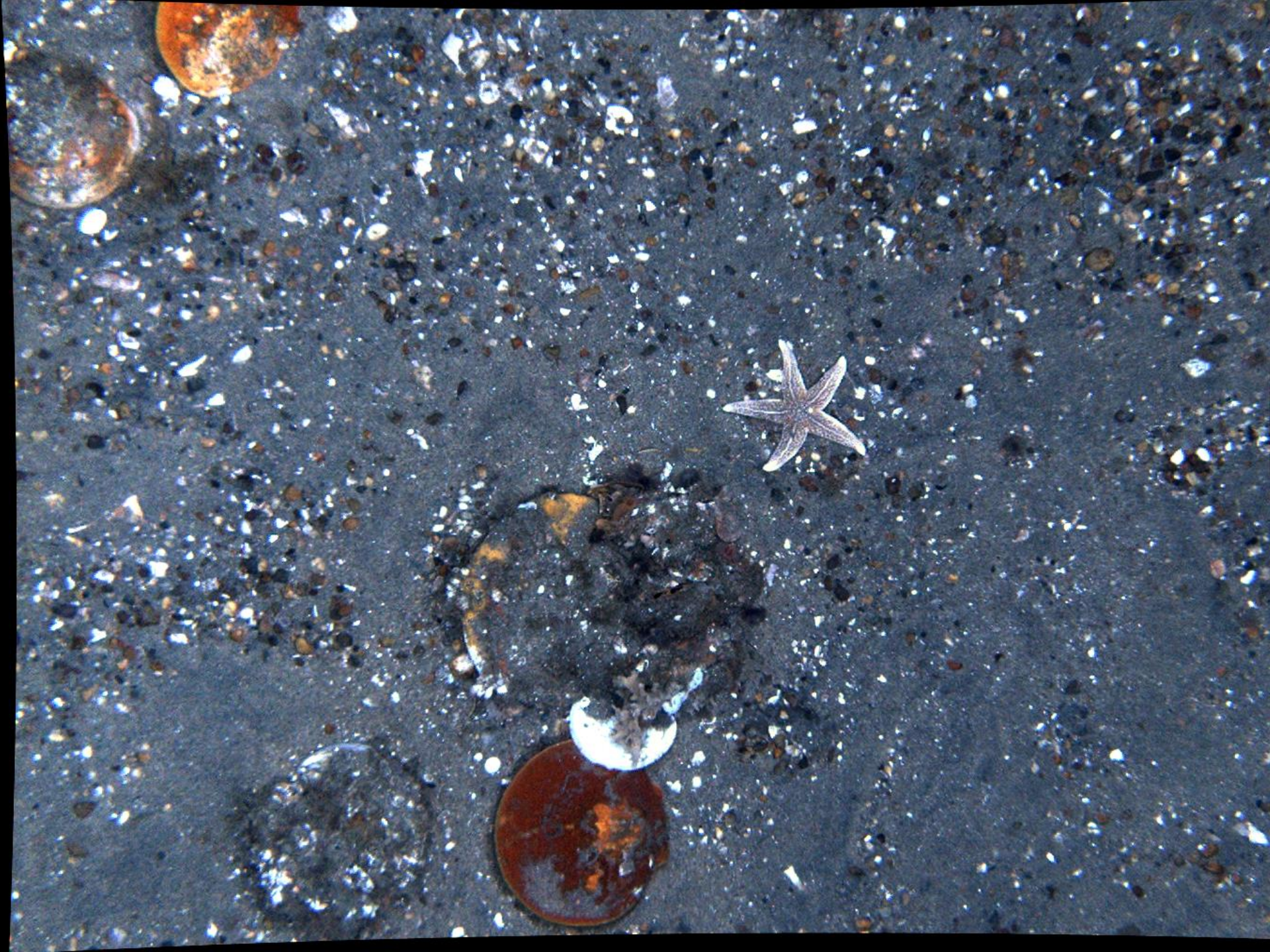


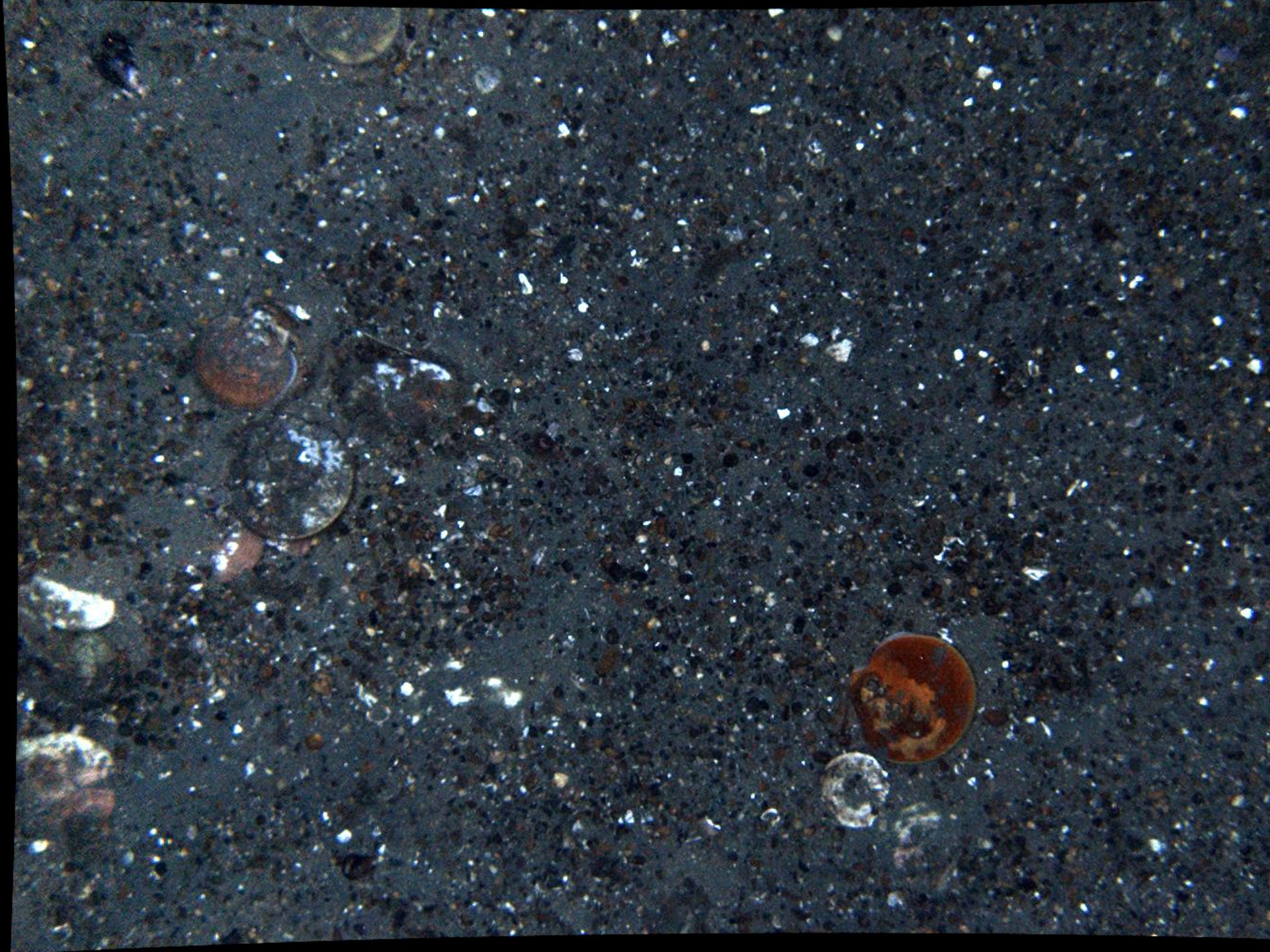
Small Scallops with Gravel (white) , Epifauna (black) , Shell Hash (brown) Contours

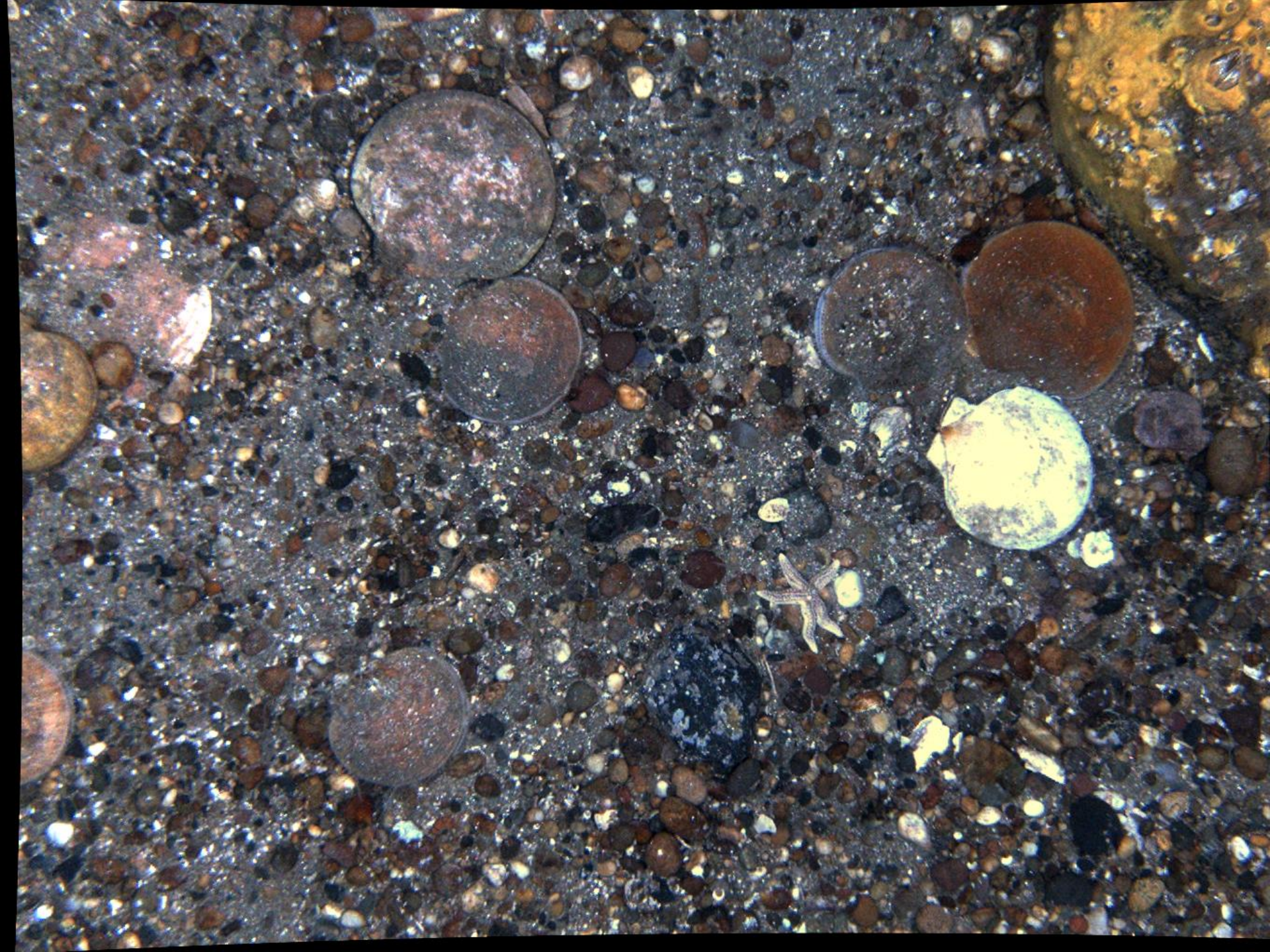


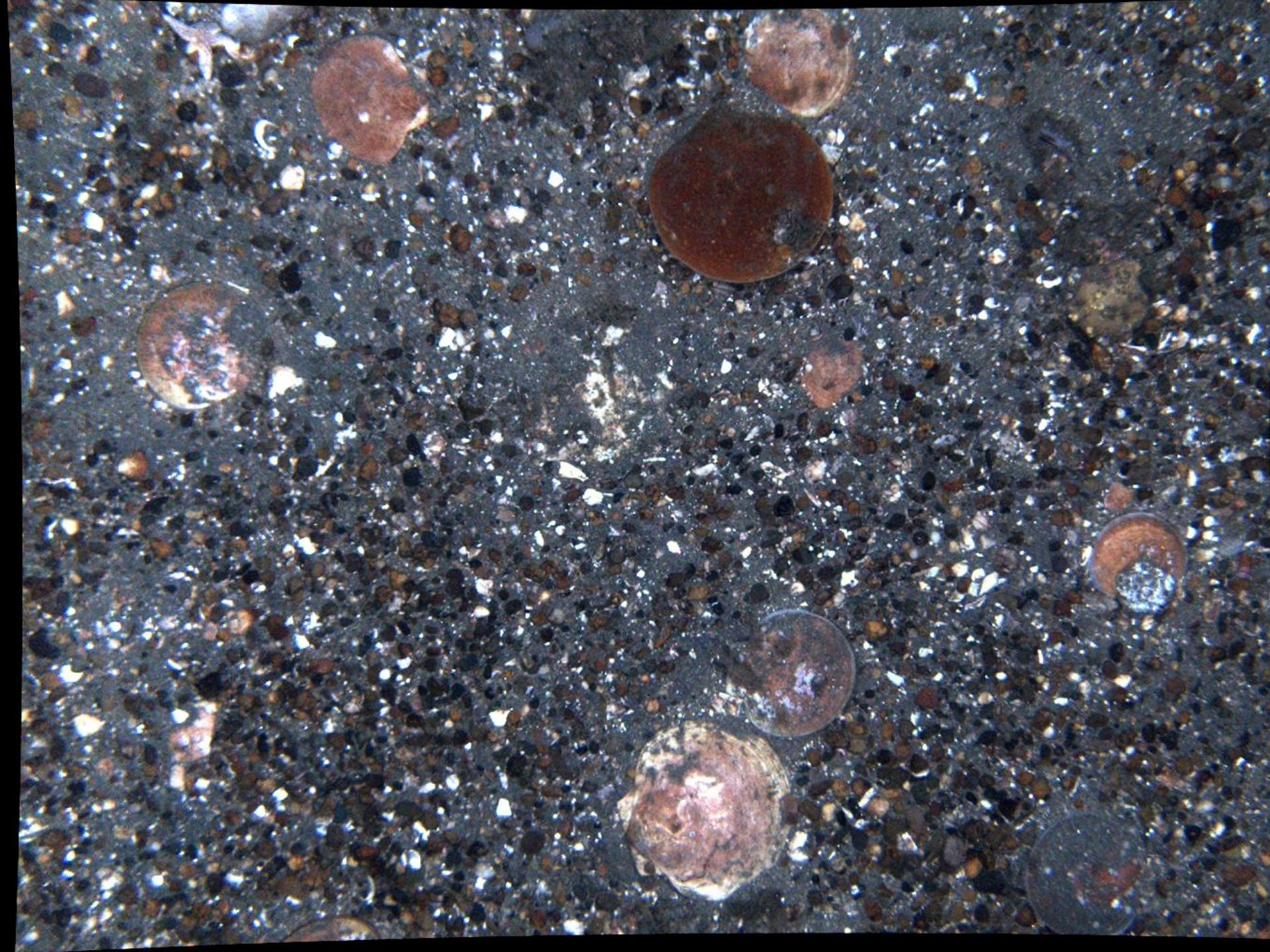
# Northern Edge Reduced Impact Area NERIA



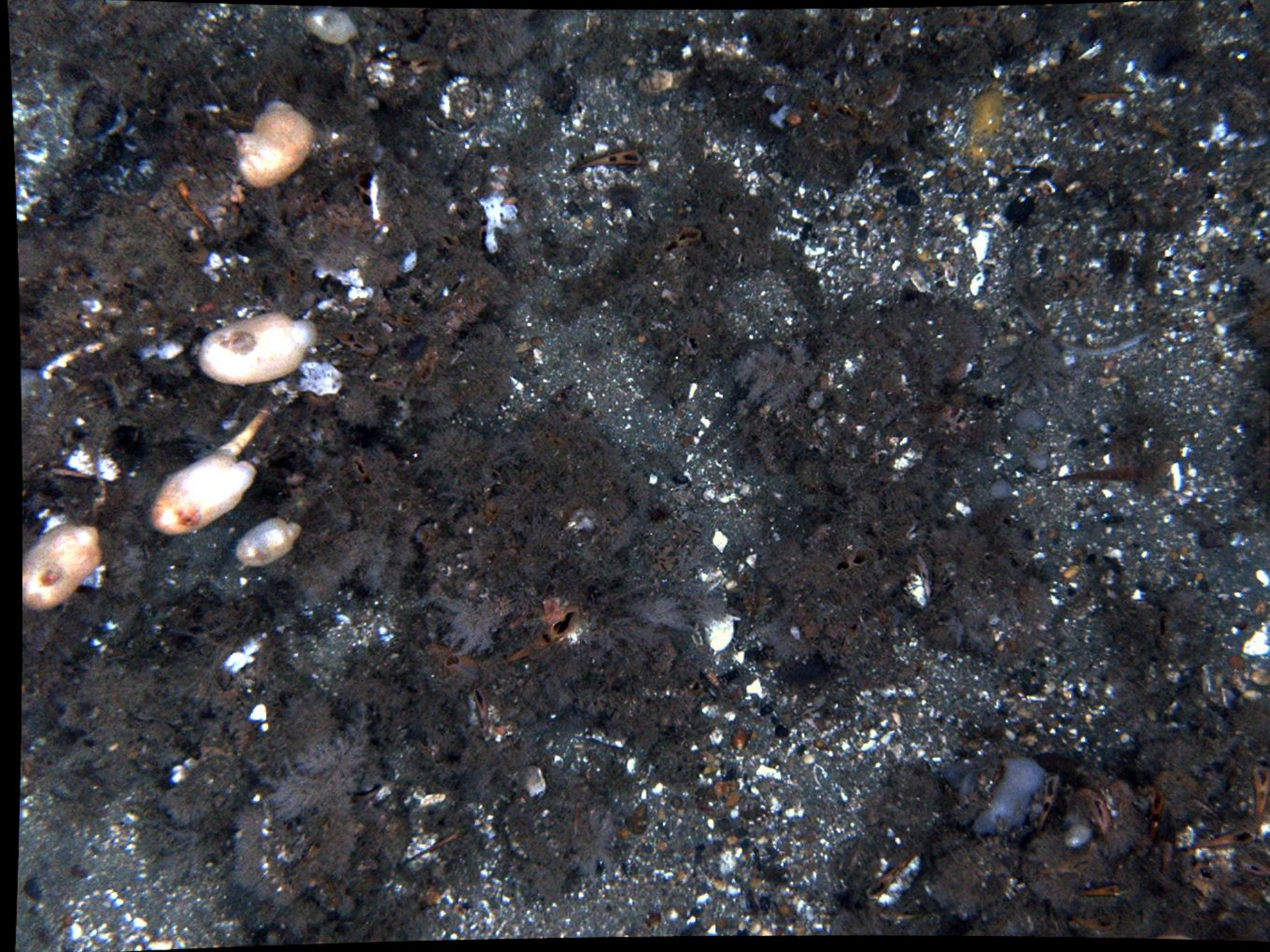


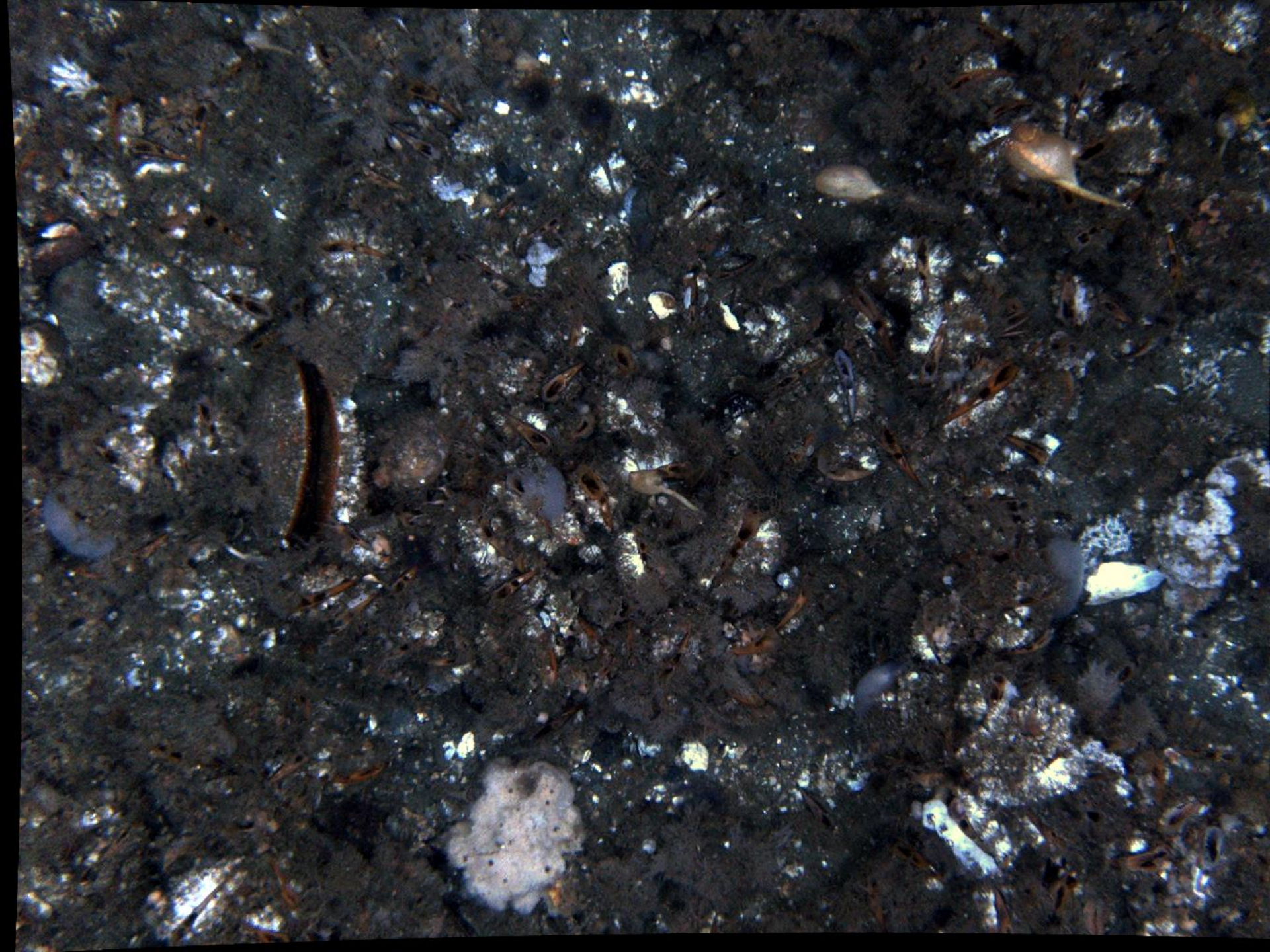


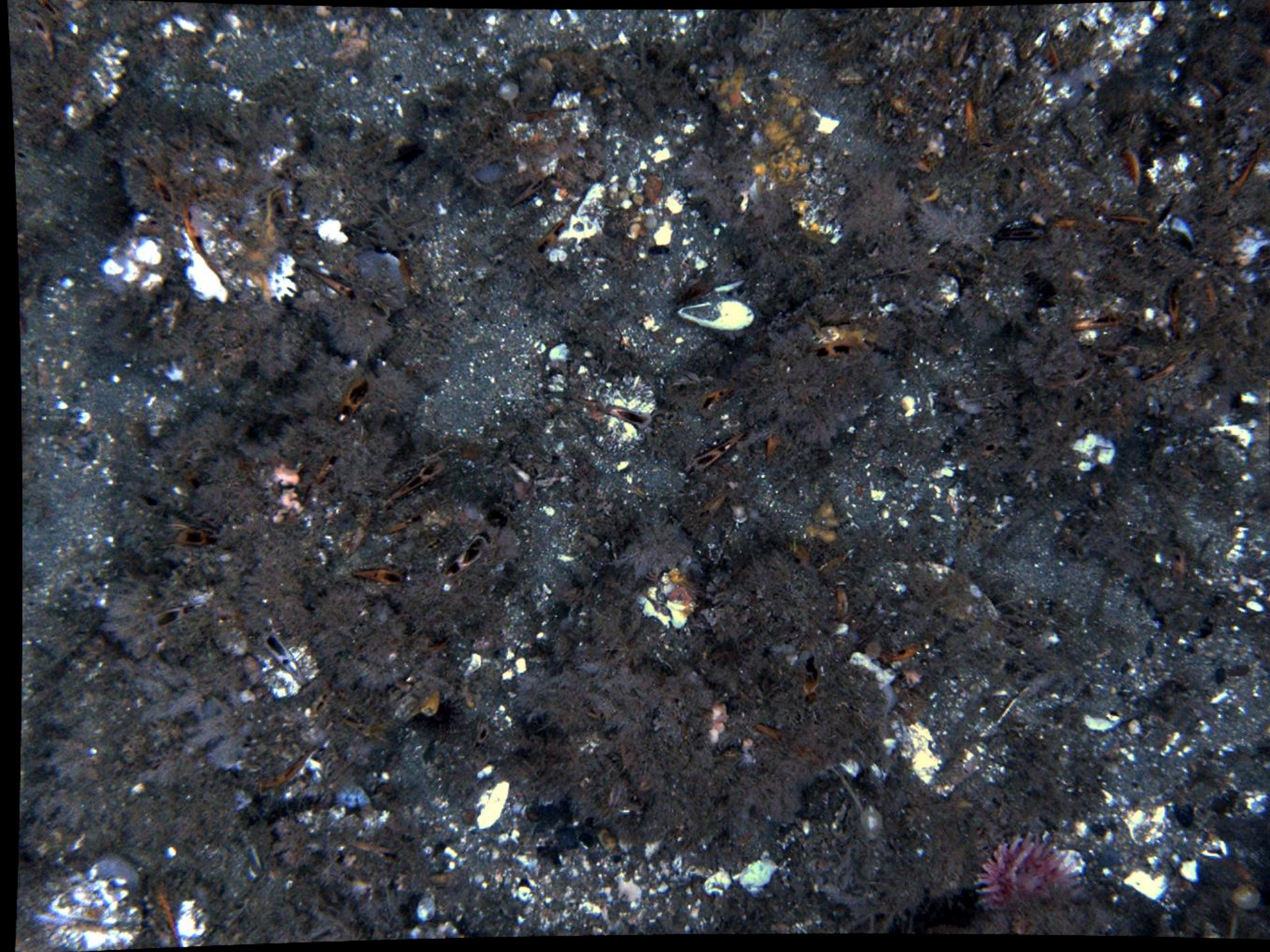




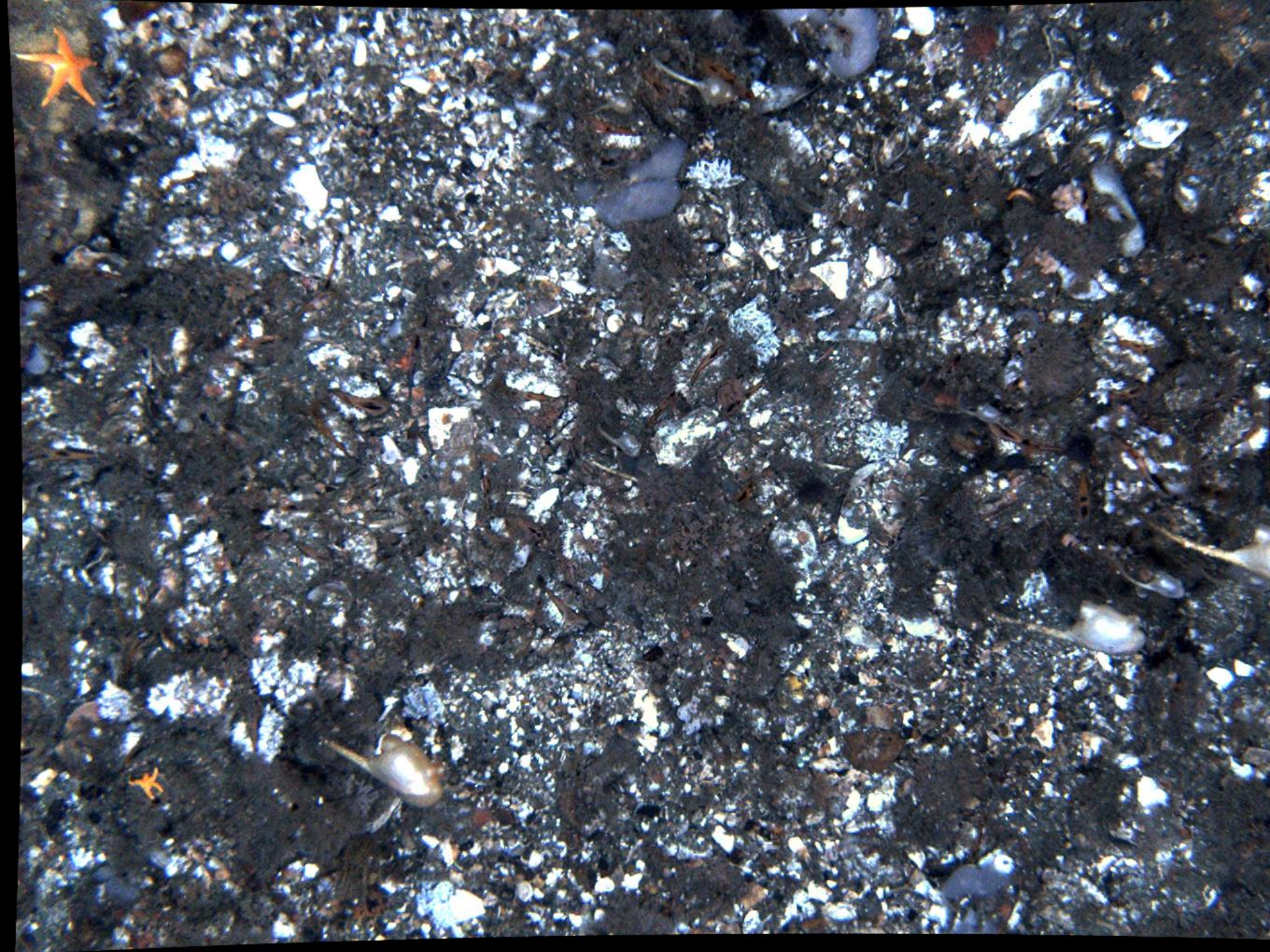




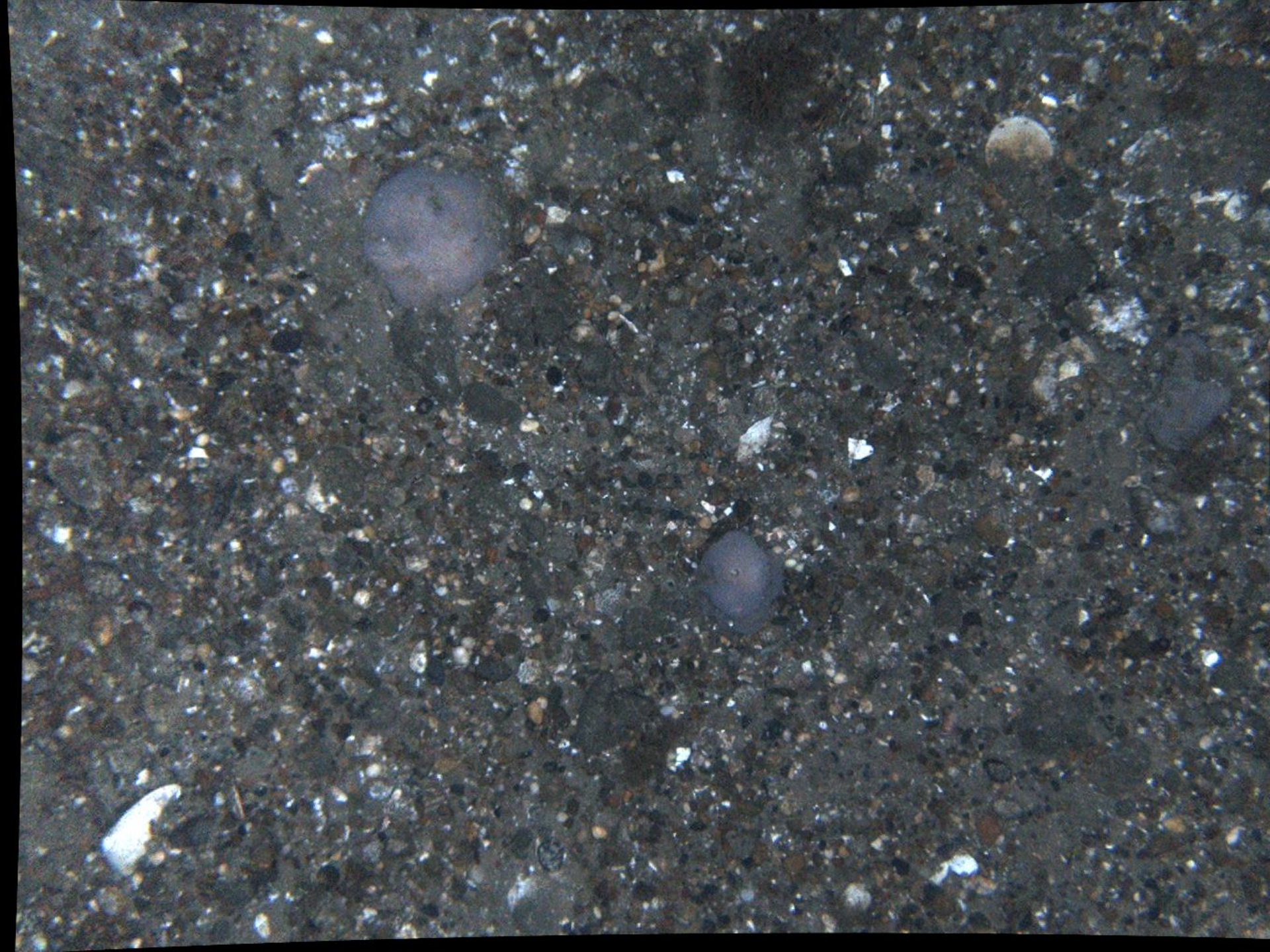


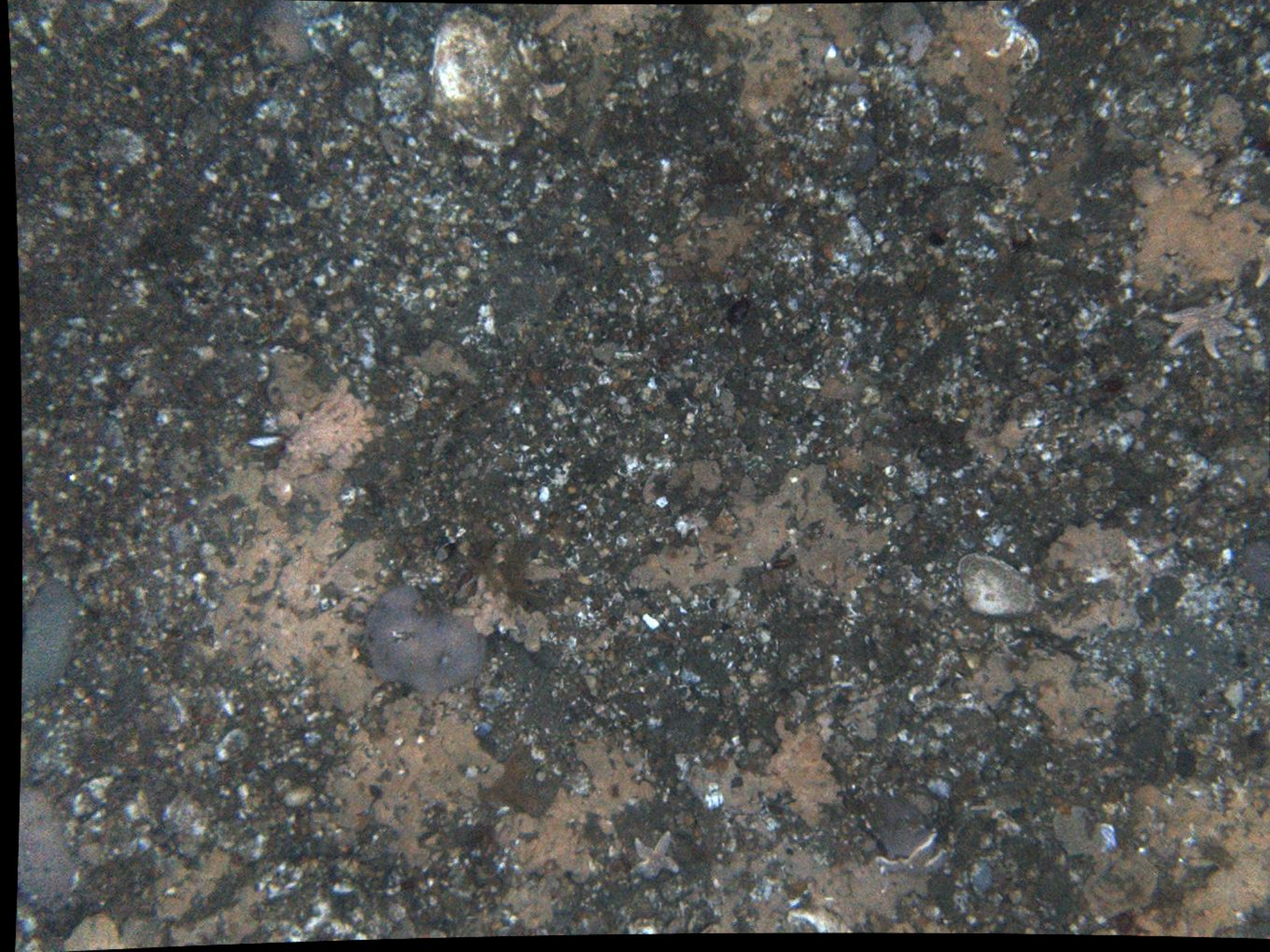




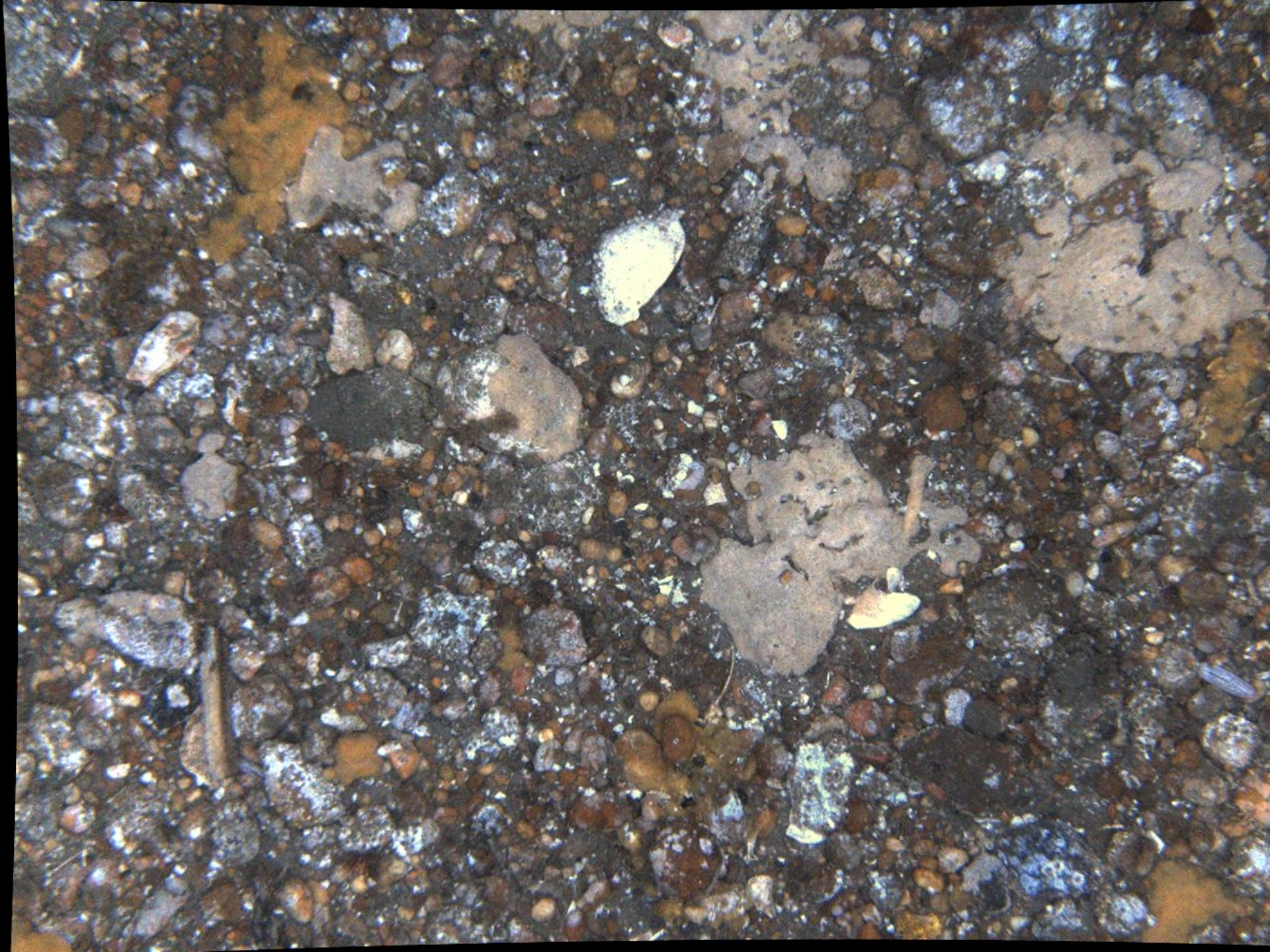


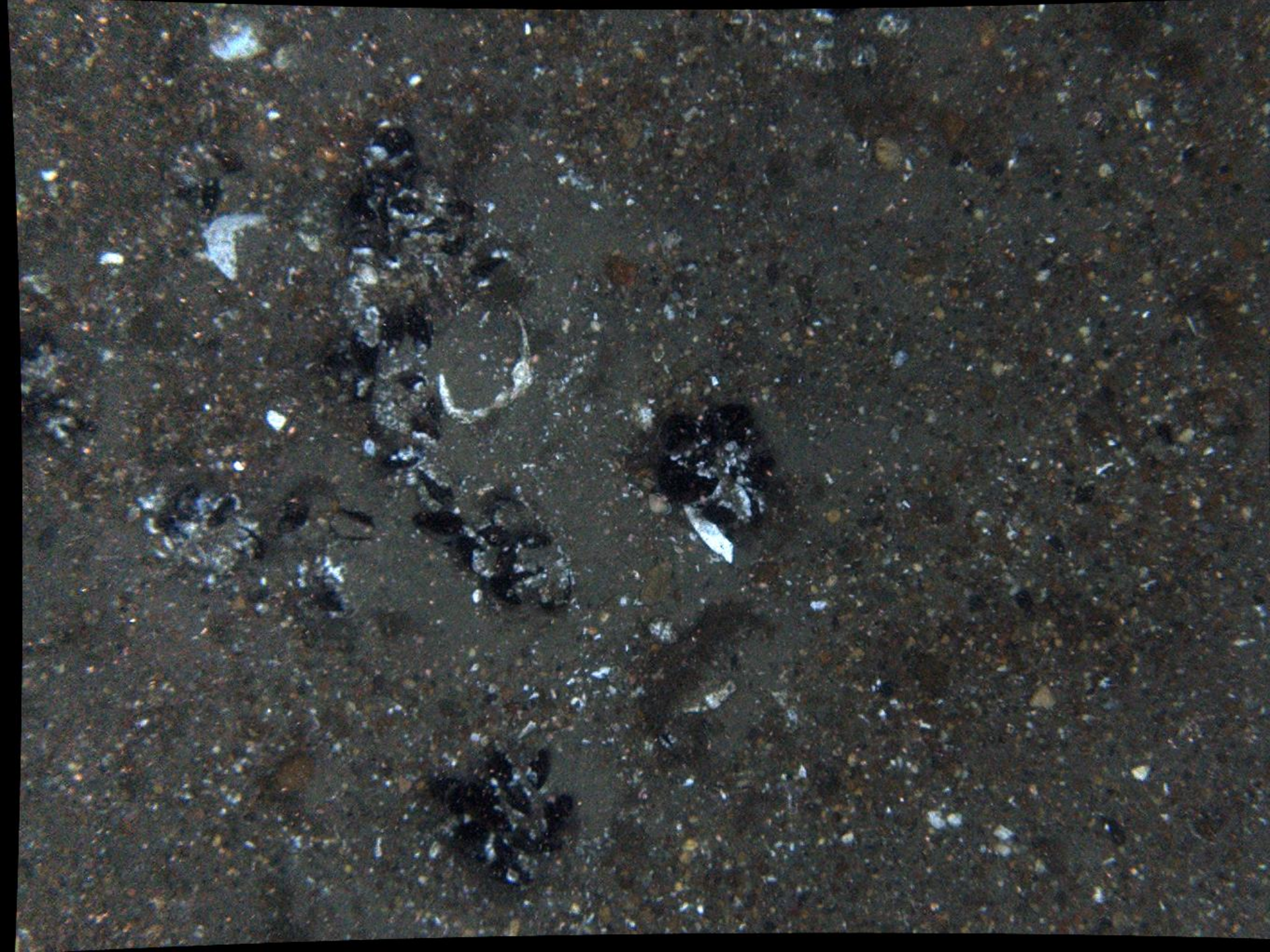
Northern Edge HMA (NEHMA)

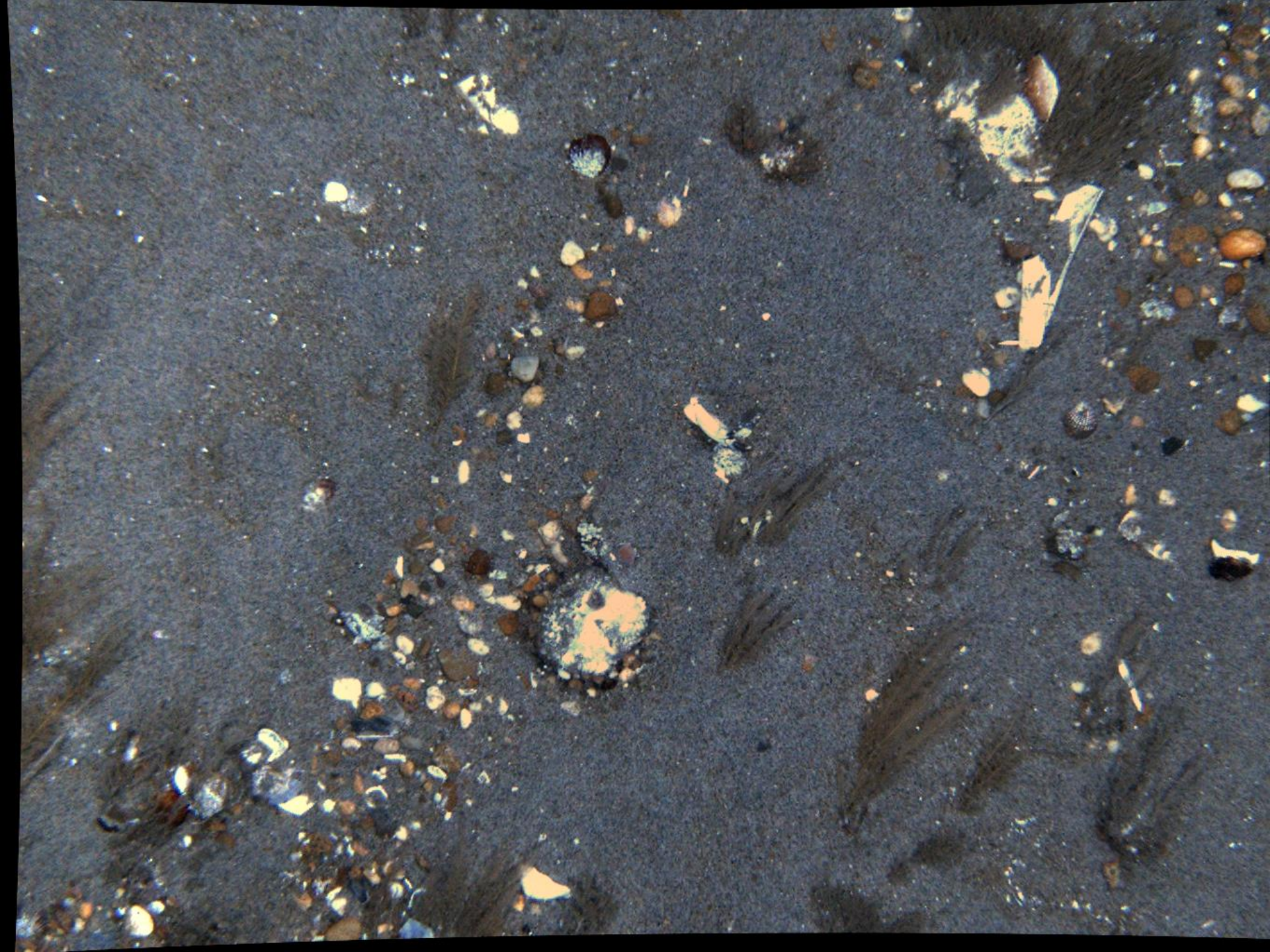


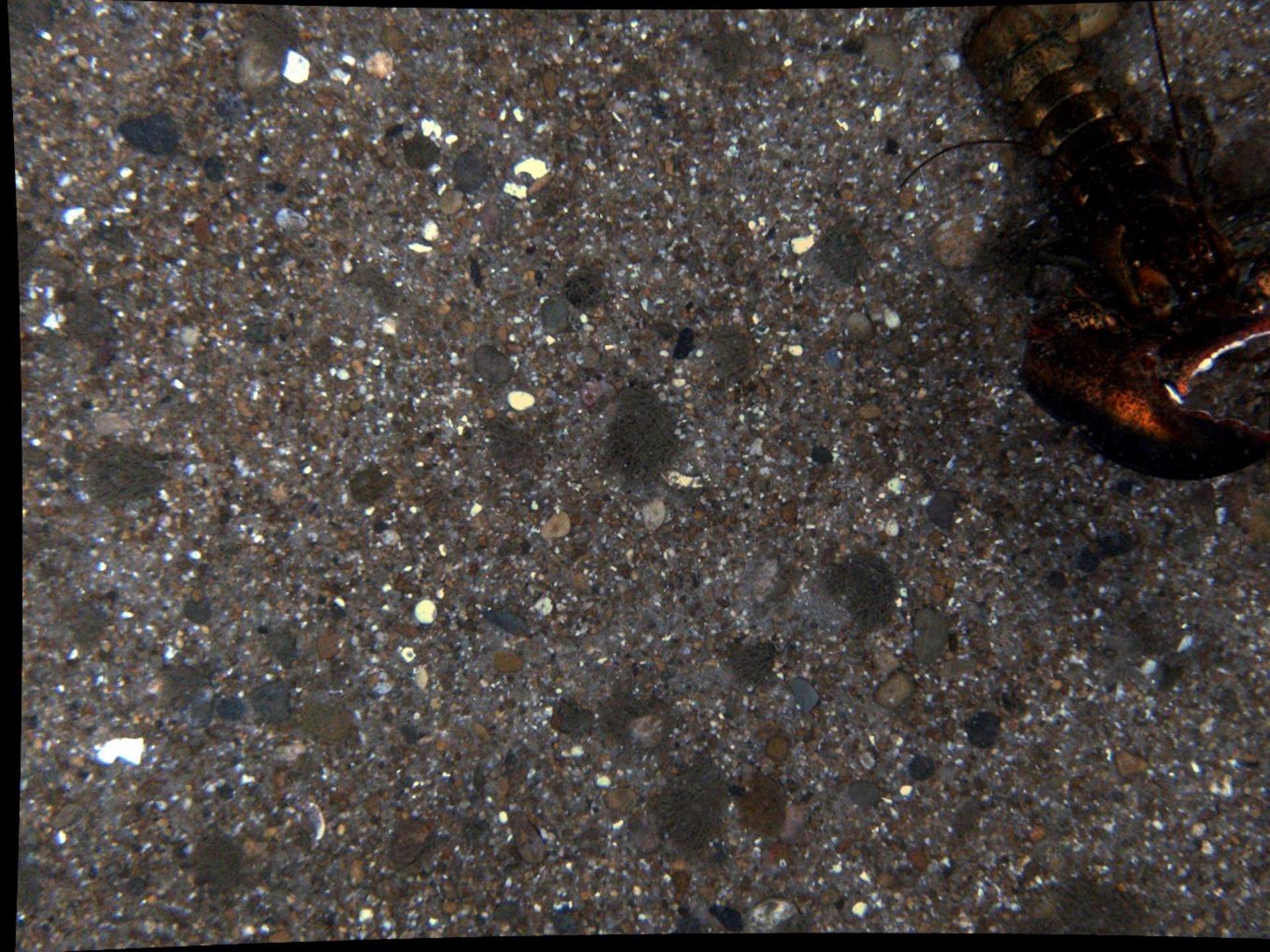


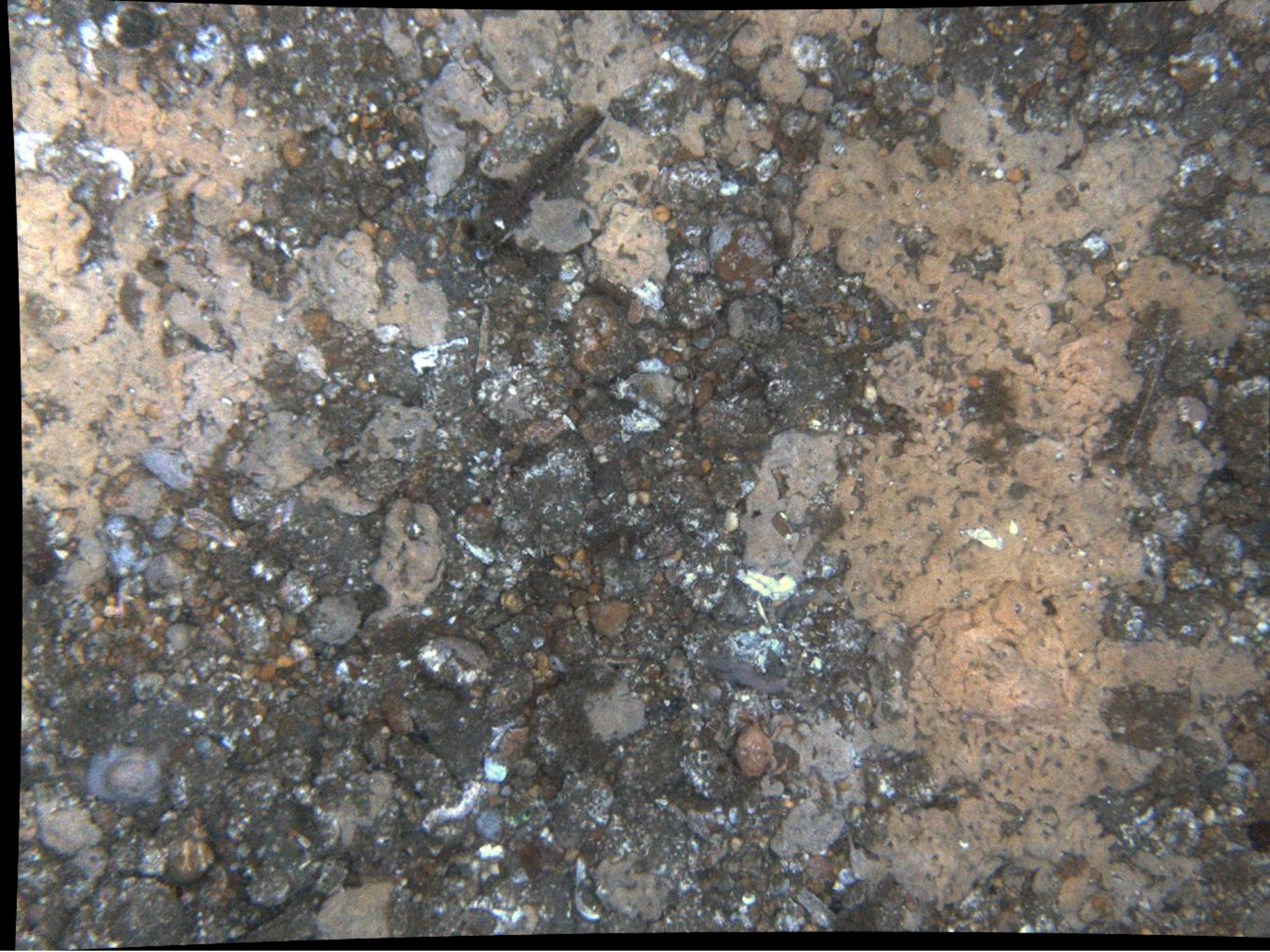




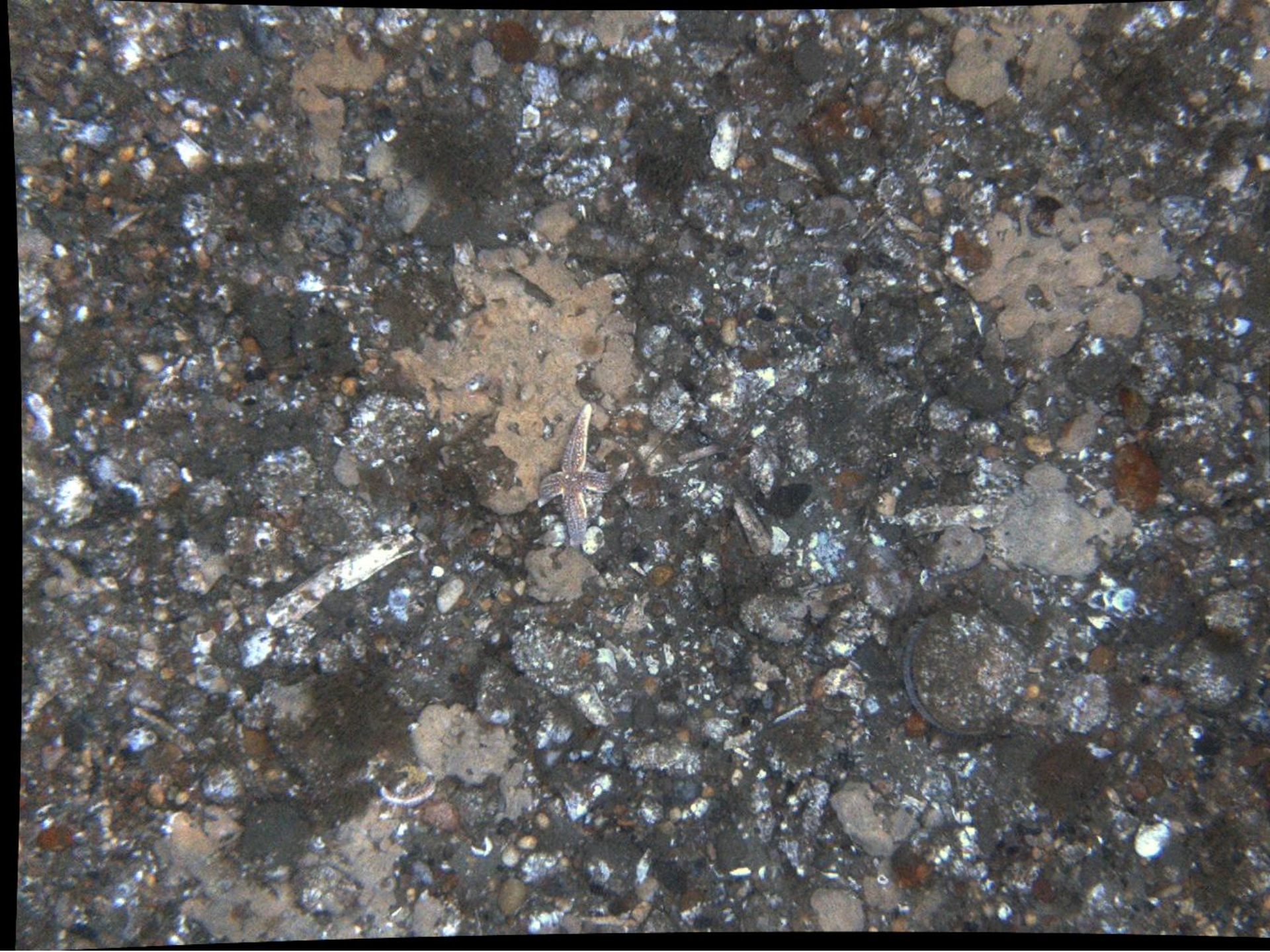








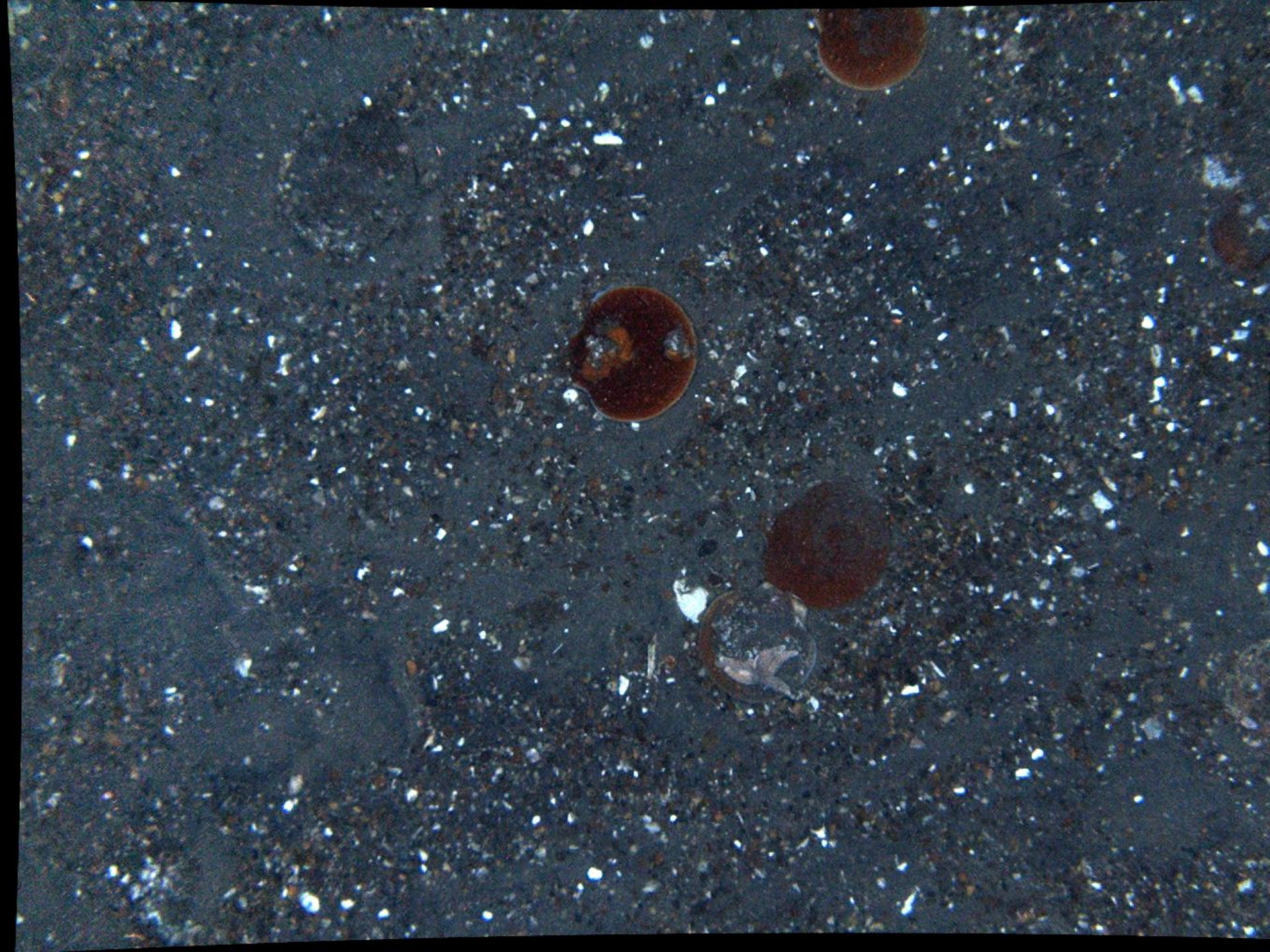


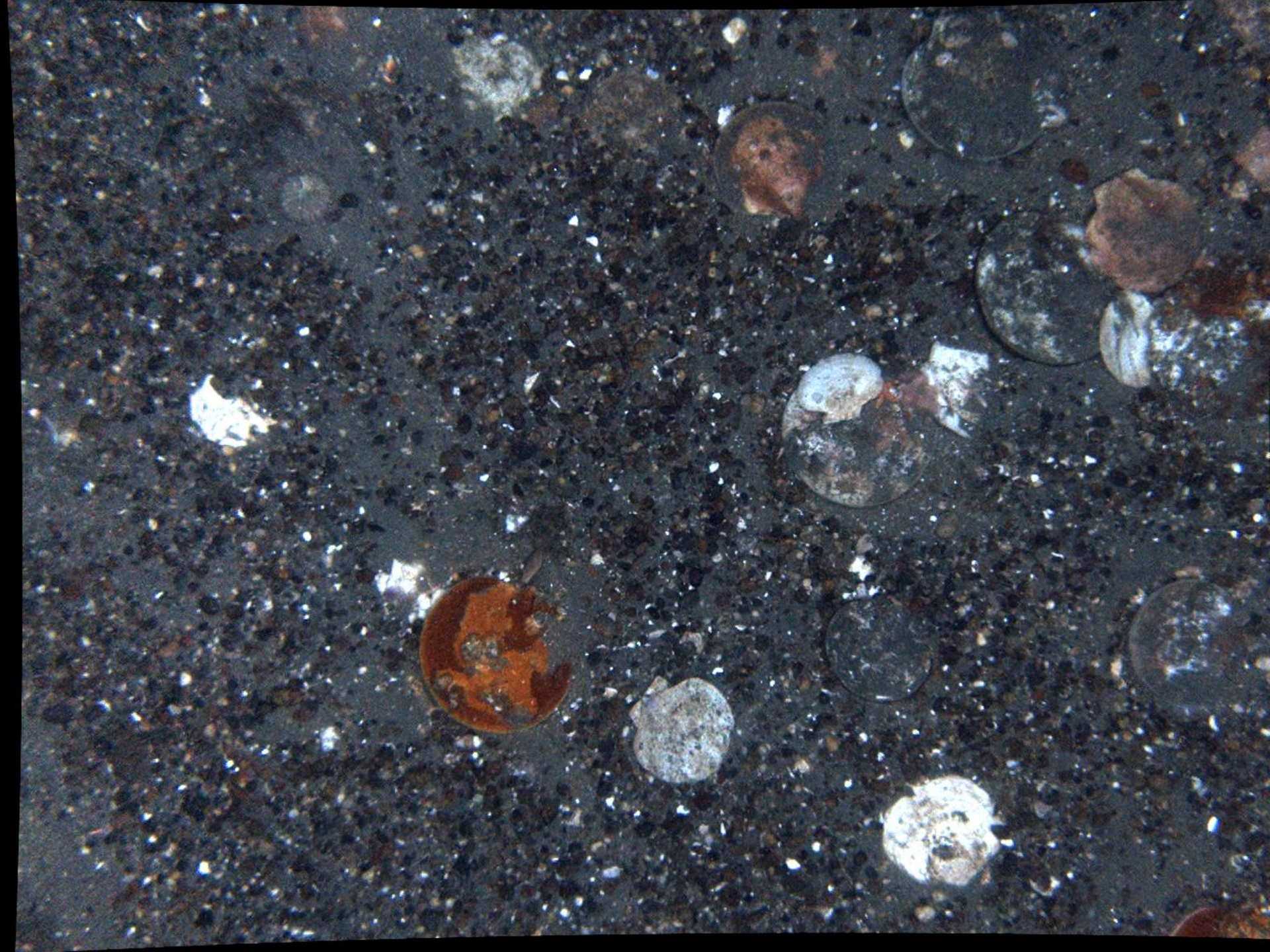


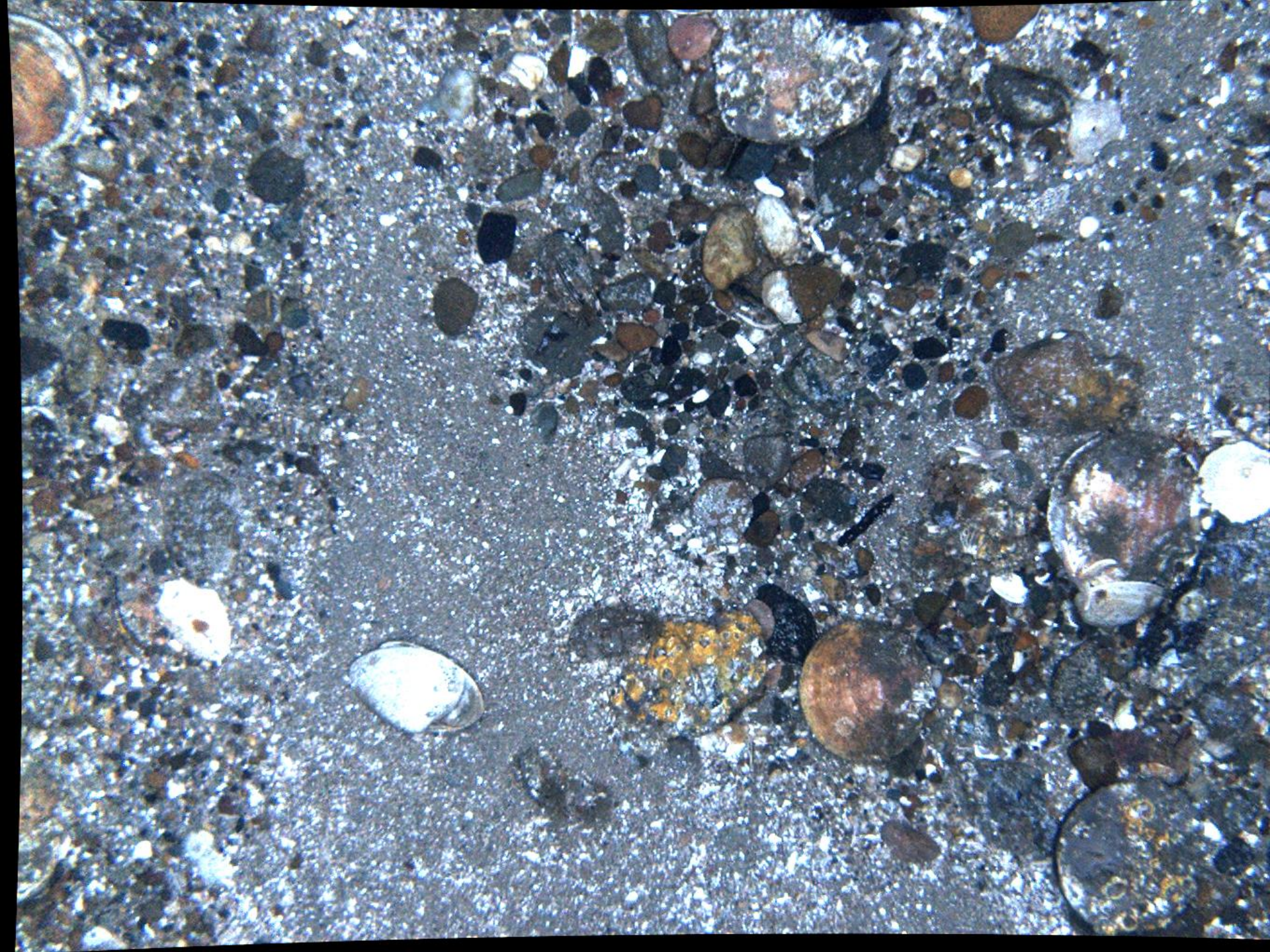
# Eastern Georges Shoals

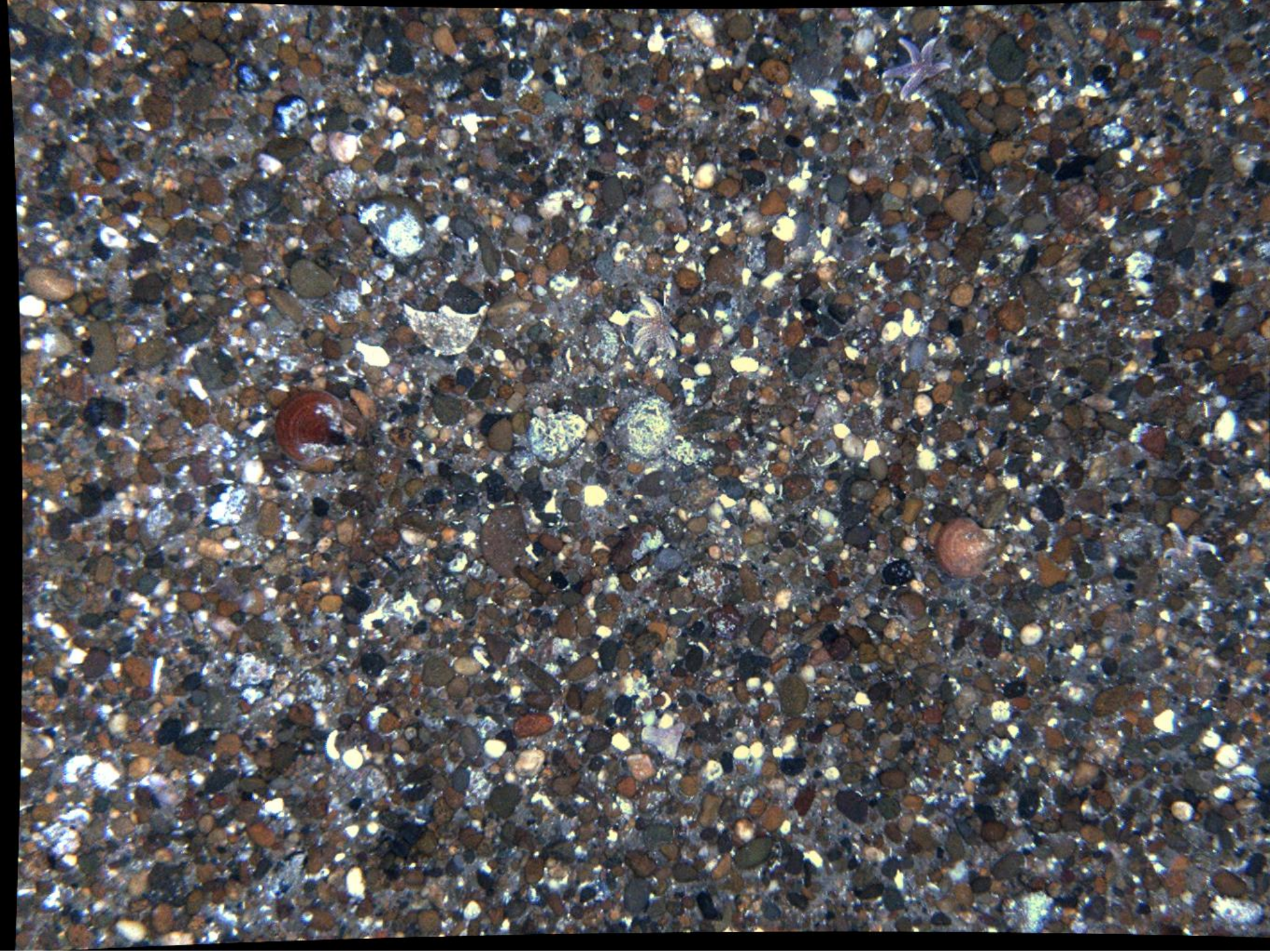
## EGS





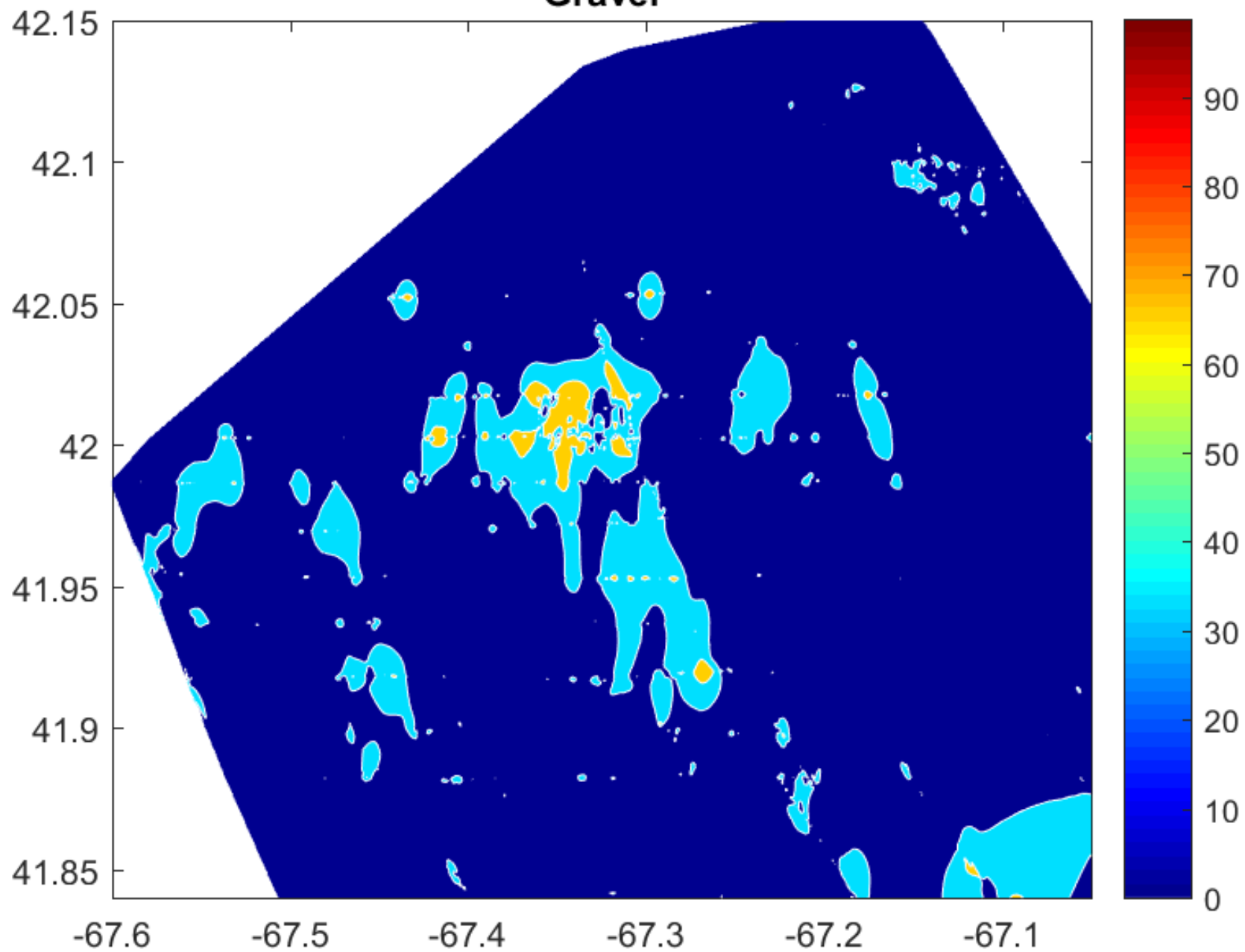








# Gravel



# Epifauna

