

## Mosaic analysis of UnderWater TeleVision (UWTV) survey data for Norway lobster

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**Abstract** – We present a spatial analysis of Norway lobster *Nephrops norvegicus* through mosaics generated in the 2018 UnderWater TeleVision survey in Functional Units 3, 4, and 33. The aim is to assess the small-scale spatial relationships between *N. norvegicus* burrows and individuals with its conspecifics and other fauna present in the area.

**Keywords** – *Nephrops norvegicus*, Use of space, Individuals, Burrows, Spatial relationships.

### I. BACKGROUND

Norway lobster (*Nephrops norvegicus*) is an important fishery resource in European waters [1]. Its stock assessments are performed with towed sledges in annual UnderWater TeleVision (UWTV) surveys, managed on a regional level of Functional Units (FUs) by national entities partnering in the ICES Working Group on *Nephrops* Surveys (WGNEPS) [2]. As a burrowing decapod, adult *N. norvegicus* construct complex tunnel systems, regularly displaying territorial behavior (dominant individuals control their burrows by being active outside during different phases of the 24h cycle) [3] Here, we present an approach to analyze towed-cam mosaics generated by DTU-Aqua, that performs the UWTV surveys in FUs 3, 4, and 33 (North Sea and Baltic Sea). Our objectives are to: a) assess the use of space by *N. norvegicus* (i.e., presence of patterns in the small-scale spatial distribution of burrows and individuals); b) assess any spatial relationships with other species; and c) compare the findings between the three FUs.

### II. METHODOLOGY

The mosaics, generated during the UWTV surveys in spring 2018, are cut into sectors of equal, manageable size (Fig 1), before being uploaded to the online tool BIIGLE (<https://biigle.de/>), where all animals and burrows are manually annotated. The data are exported for further analysis in table format, containing the image ID, label name, and pixel coordinates of the annotations. The coordinates of one dimension are then sequentially transformed to represent the continuum of the sectioned transect.



Fig. 1. Example of a short (~0.4 m long) part of a mosaic, featuring a *N. norvegicus* individual with a missing claw and facing towards a crab. The lateral green laser lines delimit the 0.7 m wide field of view.

The occurrence of animals or burrows within a spatially-defined sampling unit is treated as a Poisson event, with the expected counts  $\lambda$  being equal to the mean of the total counts in the study area across all sampling units. This can reveal patterns in the use of space by *N. norvegicus* (i.e., random, uniform or clustered burrow distribution). Furthermore, the affinity of an individual to a single burrow is assessed using distances between individuals and burrows, as well as the ratio of door-keeping behavior [4]. These, alongside inter-species spatial associations (i.e., with other benthic species visible in

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the mosaics) are further checked by probabilistic comparisons of nearest neighbor and spatial autocorrelation analyses. Finally, findings are compared among the three FUs, to assess any behavioral differences that could indicate environmental forcing, biogeographic or even genetic segregation in the behavioral phenotype of *N. norvegicus* subpopulations.

### III. DISCUSSION AND CONCLUSIONS

The current stock assessment protocols for *N. norvegicus* established and followed by ICES operators, use only burrow density extracted manually in almost real time, as the most reliable/adequate metric due to strong territorial behavior. Here, we expand on this approach by including the analysis of individuals, to tackle potential biases and deviations originated from the general assumption “1 burrow = 1 animal”. Furthermore, we move beyond the state-of-the-art by using image collection and analysis tools to study the behavior of a marine species and its associated community over an extended surface.

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