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Automated Marine Growth Analysis

Project Background

- BMT Cordah Ltd. Have been undertaking marine growth assessments since the early 1980's
- Industry challenges – access to data, data sharing, innovative monitoring, cost savings, efficiency
- Dr David Kline, Scripps Institute of Oceanography, San Diego
- Oscar Beijbom, "Automated Annotation of Coral Reef Survey Images". PhD Thesis UCSD, June 2015
 - CoralNET Project - a web solution for coral reef analysis

“Global and local stressors have caused a rapid decline of coral reefs across the world. To monitor the changes and take appropriate action large spatio-temporal surveys are needed. Data collection speeds are typically sufficient to meet this need but the subsequent image analysis remains slow as manual inspection of each photo is required. This creates a 'manual annotation bottleneck’”.

“CoralNet reduces this bottleneck by allowing modern computer vision algorithms to be deployed alongside human experts. Often 50-100% automation can be achieved with minimal reduction in the quality of the final data-product. CoralNet, by its nature, also provides a platform for collaboration & sharing of data”.

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- Following

Scalebar	ScIBar	Other
Unknown	Unk	Other
Water	WATE	Other
Algae	Algae	Algae

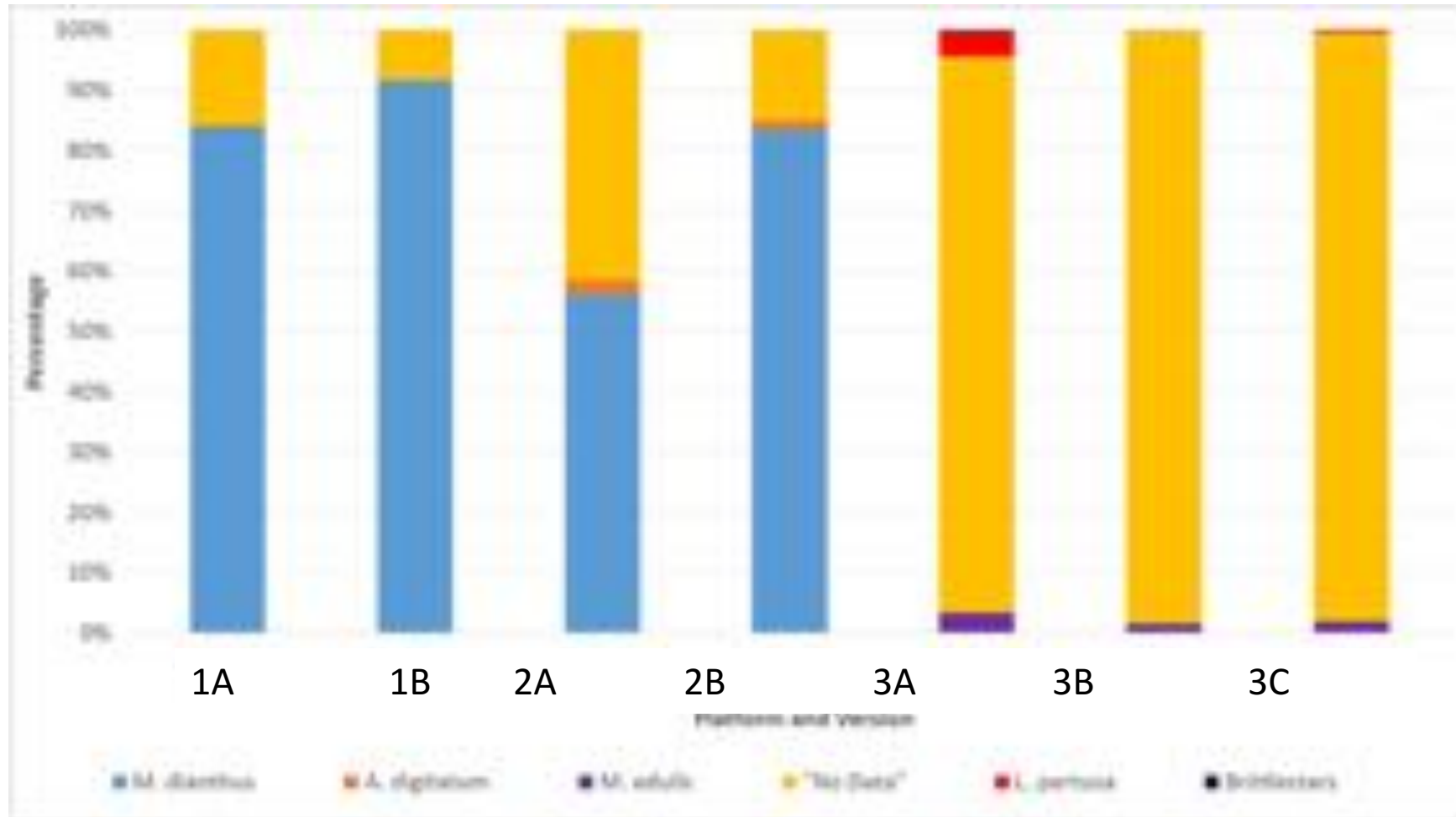
used for testing

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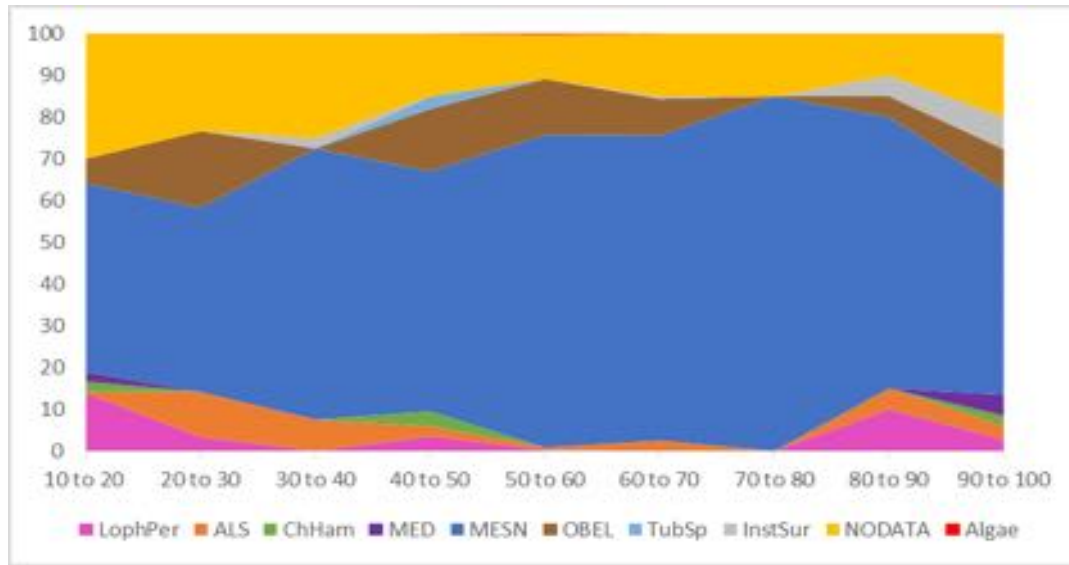
Analysis

Testing Method	Name	Confidence Threshold	Annotation Point Generation	No. of Images	No. Images in Classifier
A	Platform 1A	80%	<ul style="list-style-type: none"> Image annotation area: X: 10 - 95% / Y: 10 - 95% 20 random points 	73	857
	Platform 2A	90%		95	930
	Platform 3A	80%		69	1322
B	Platform 1B	90%	<ul style="list-style-type: none"> Image annotation area: X: 10 - 95% / Y: 10 - 95% Stratified random¹, 5 rows x 5 columns of cells, 2 points per cell (total of 50 points) 	73	1025
	Platform 2B			95	1025 and 1142*
	Platform 3B			68	1193
C	Platform 3C	90%	<ul style="list-style-type: none"> Image annotation area: X: 15 - 90% / Y: 15 - 90% Uniform grid, 10 rows x 10 columns (total of 100 points) 	66	1261

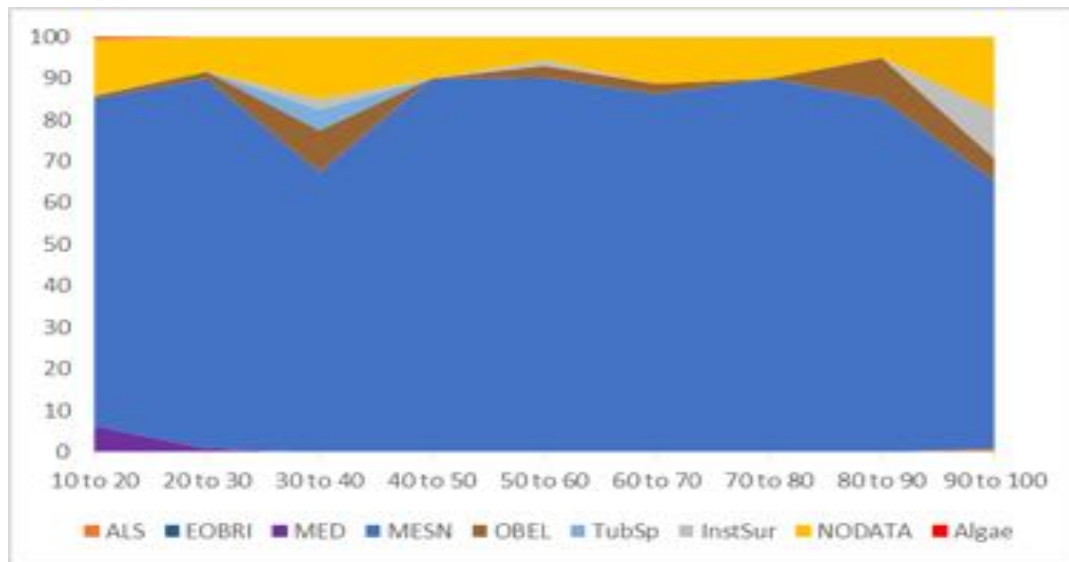
Results



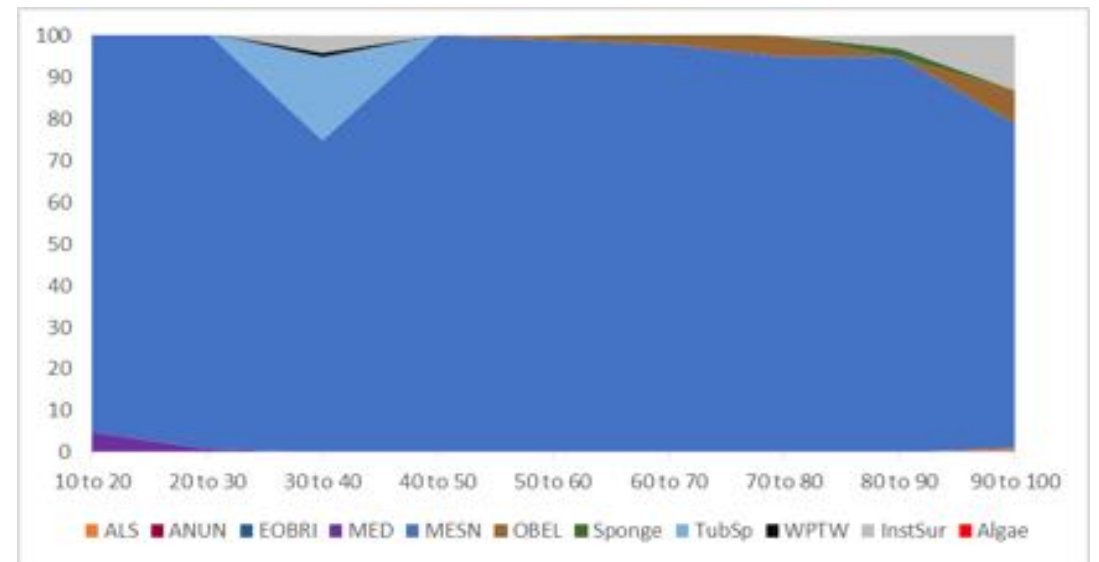
Platform 1A



Unconfirmed

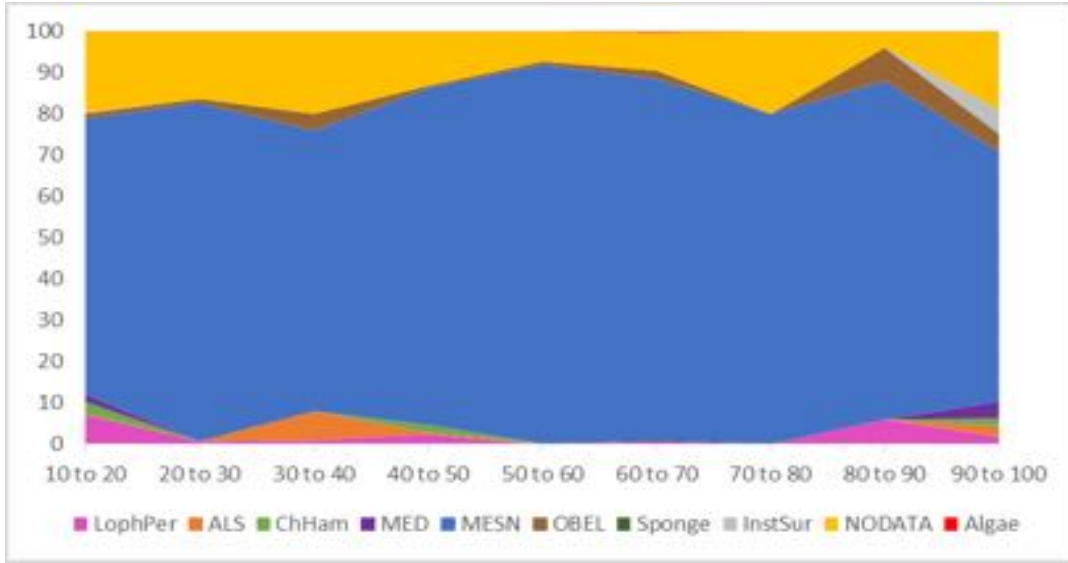


Confirmed

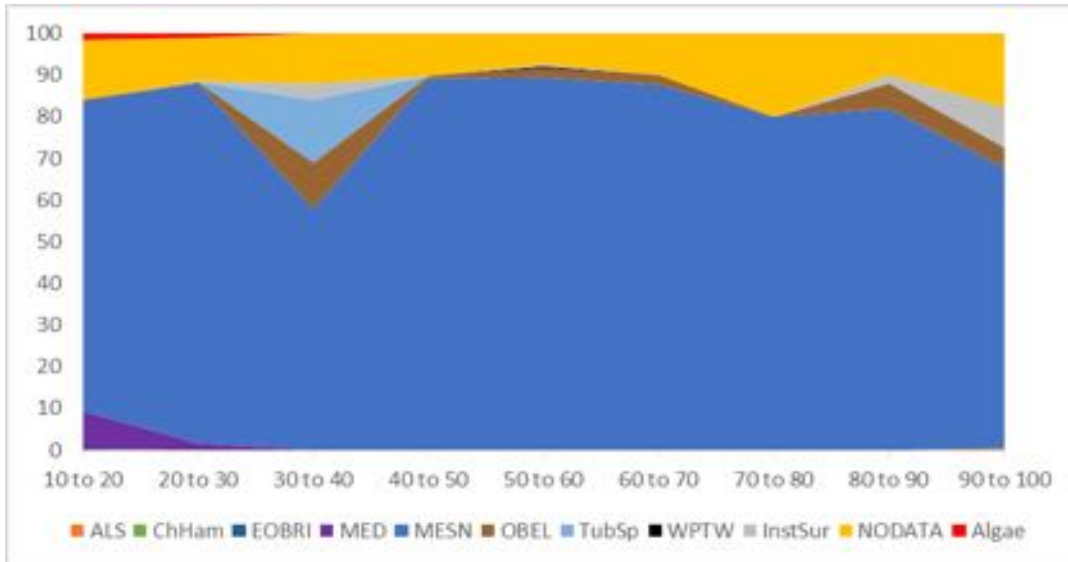


Eye

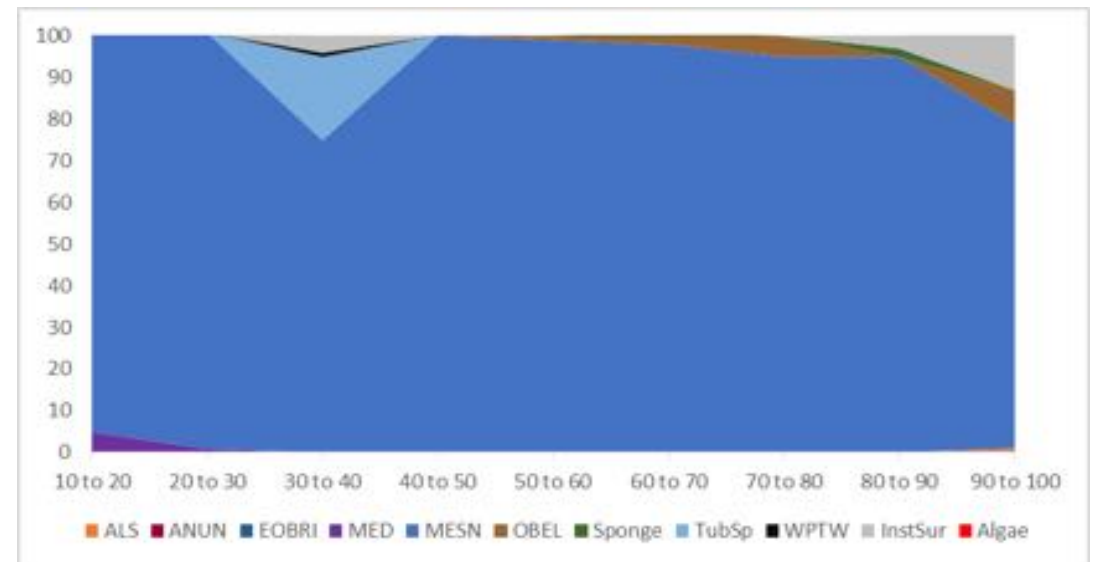
Platform 1B



Unconfirmed

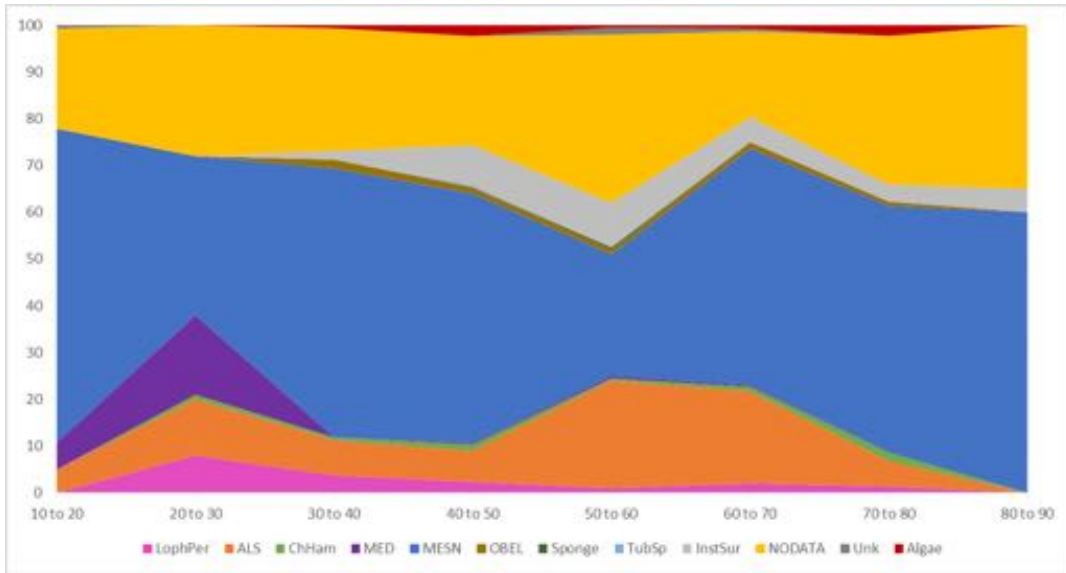


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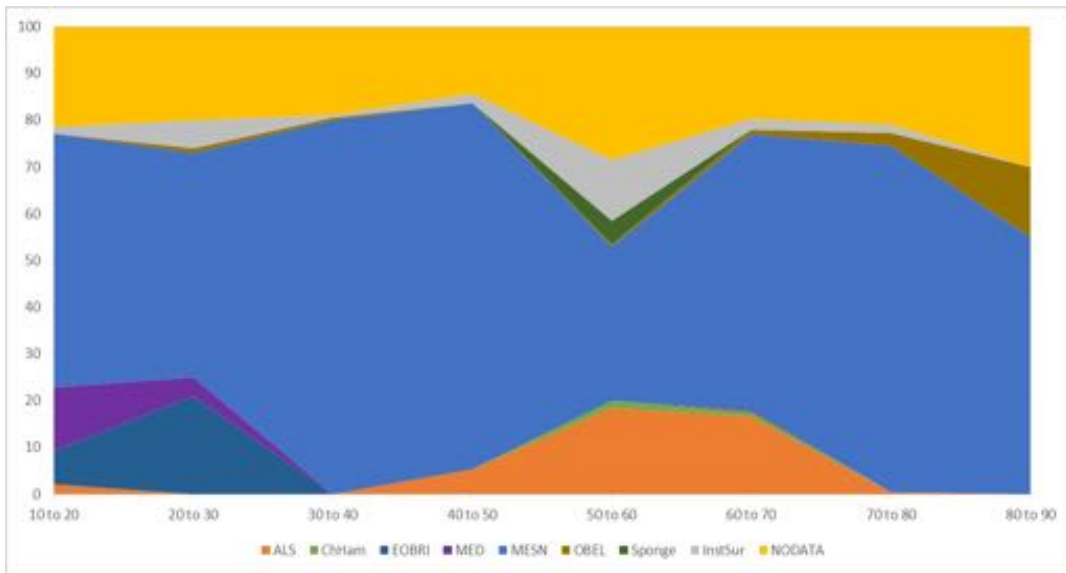


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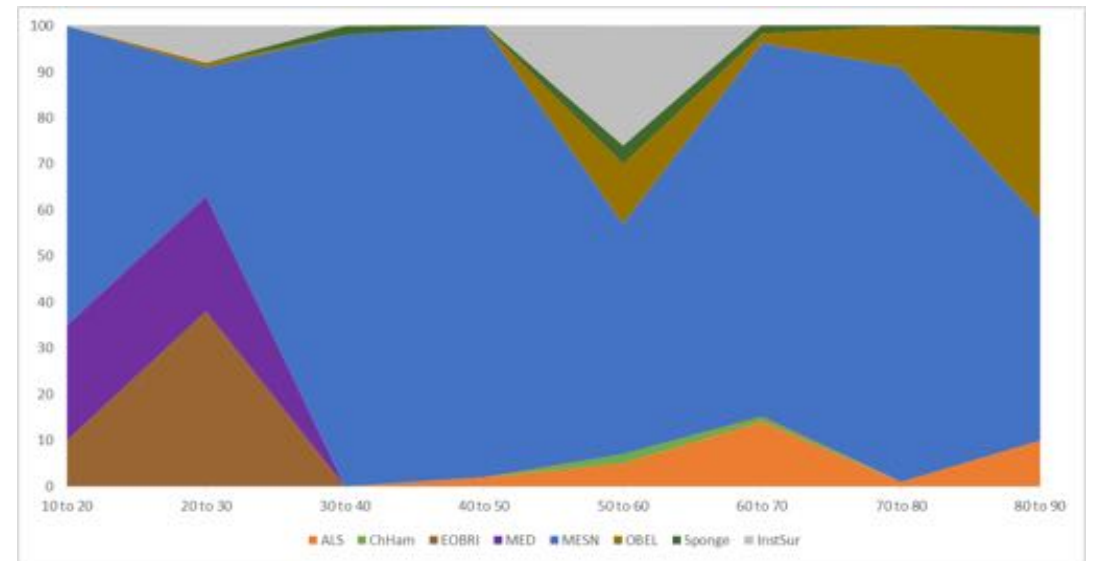
Platform 2A



Unconfirmed

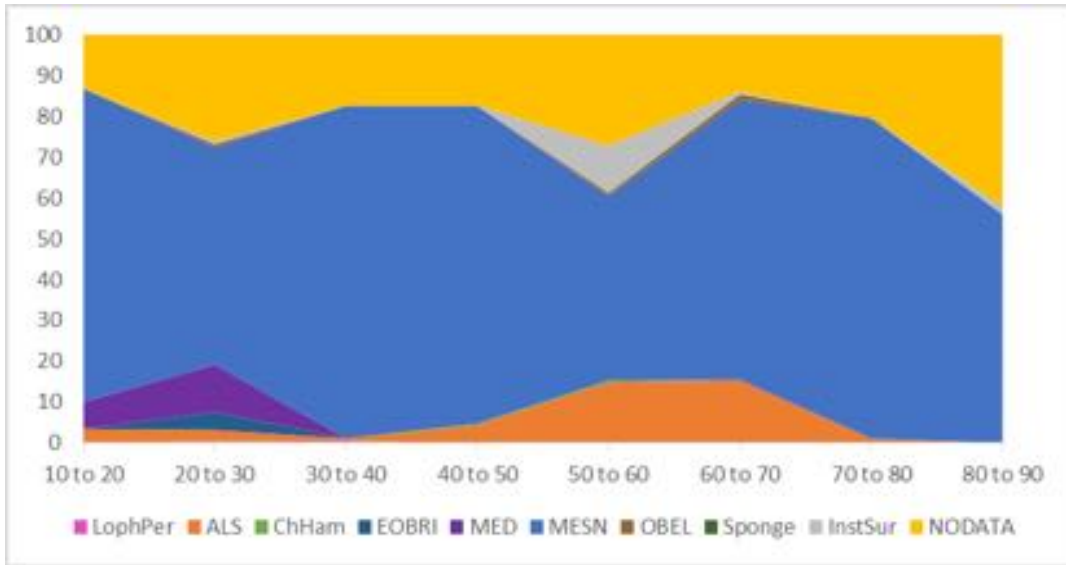


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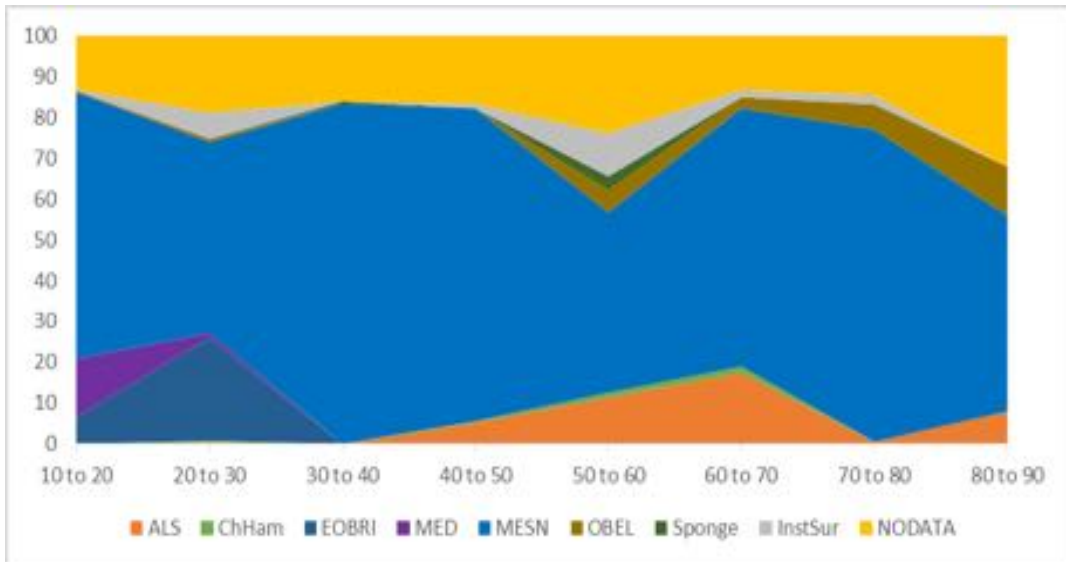


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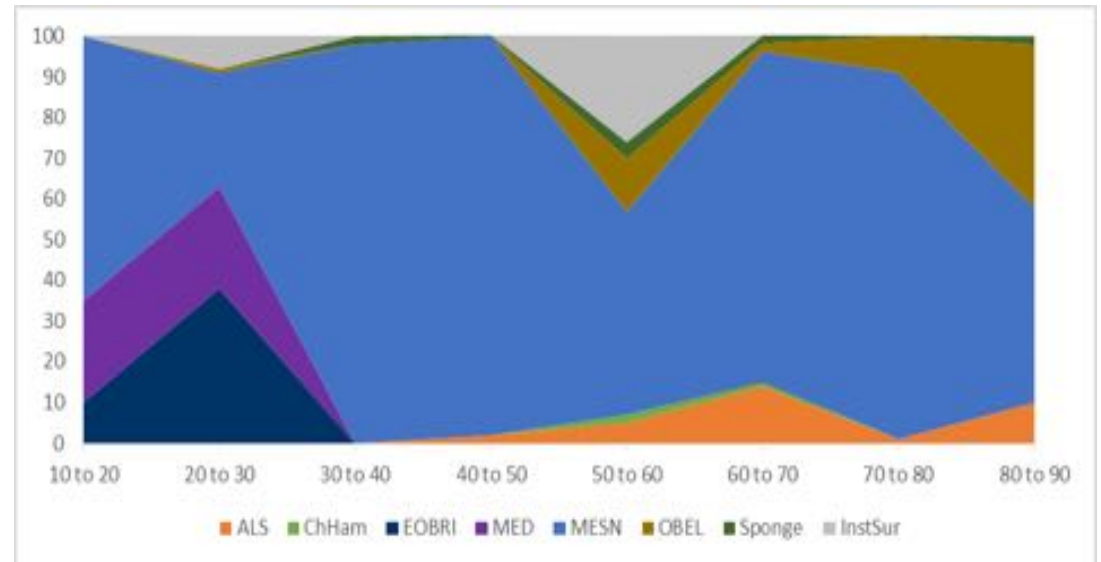
Platform 2B



Unconfirmed

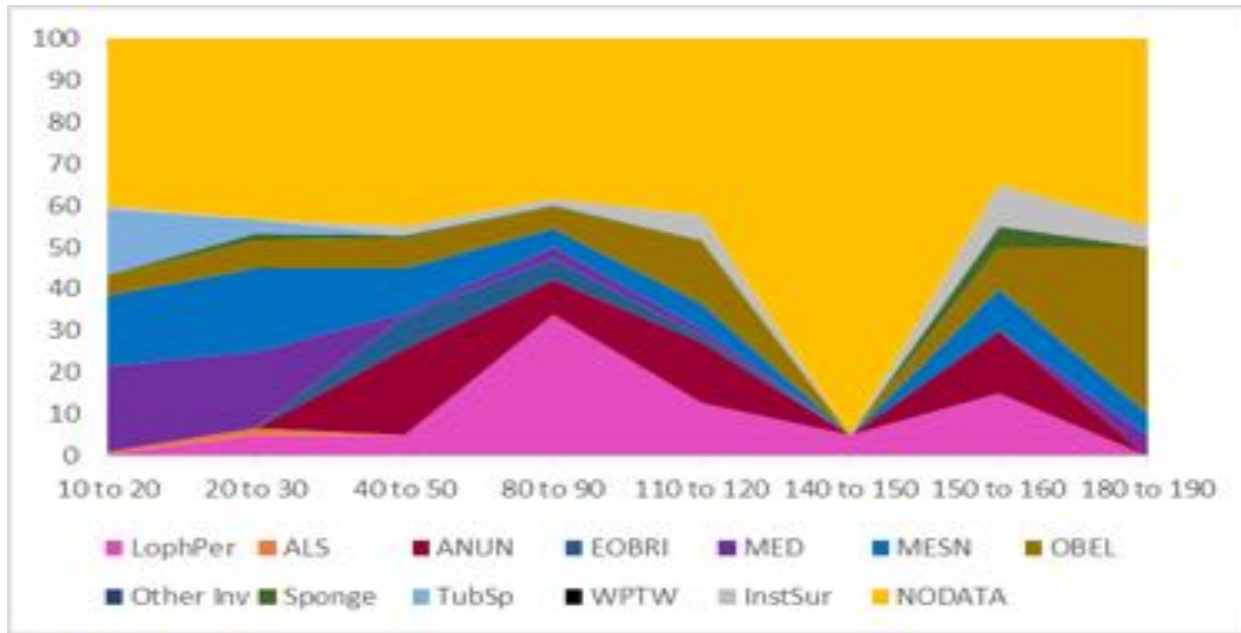


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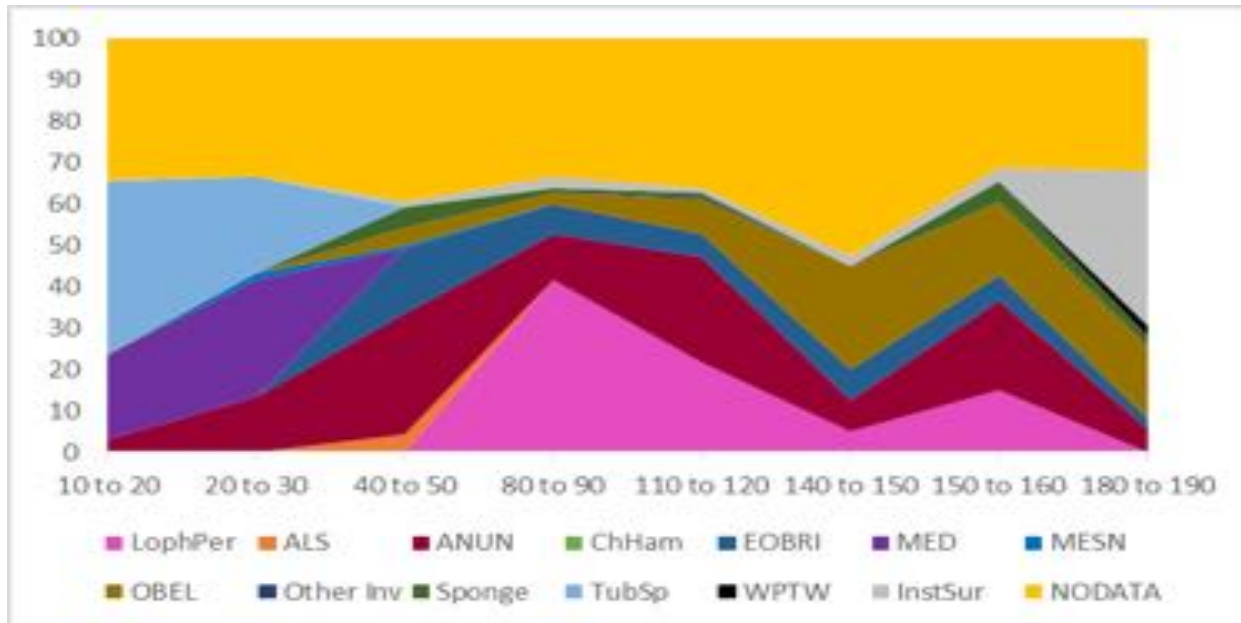


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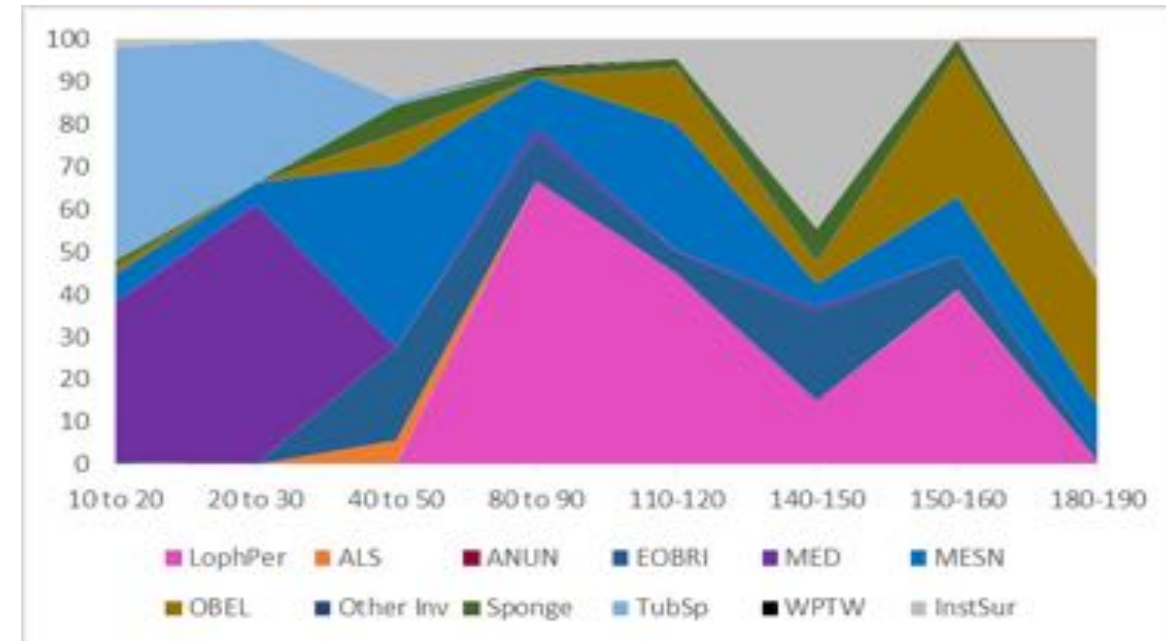
Platform 3A



Unconfirmed

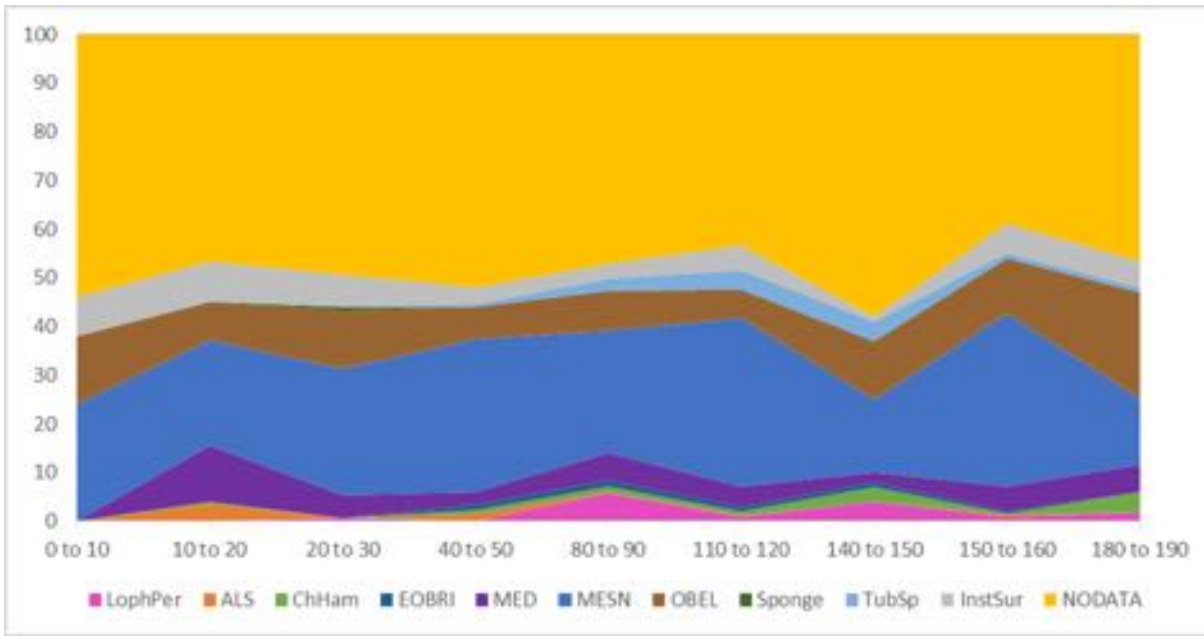


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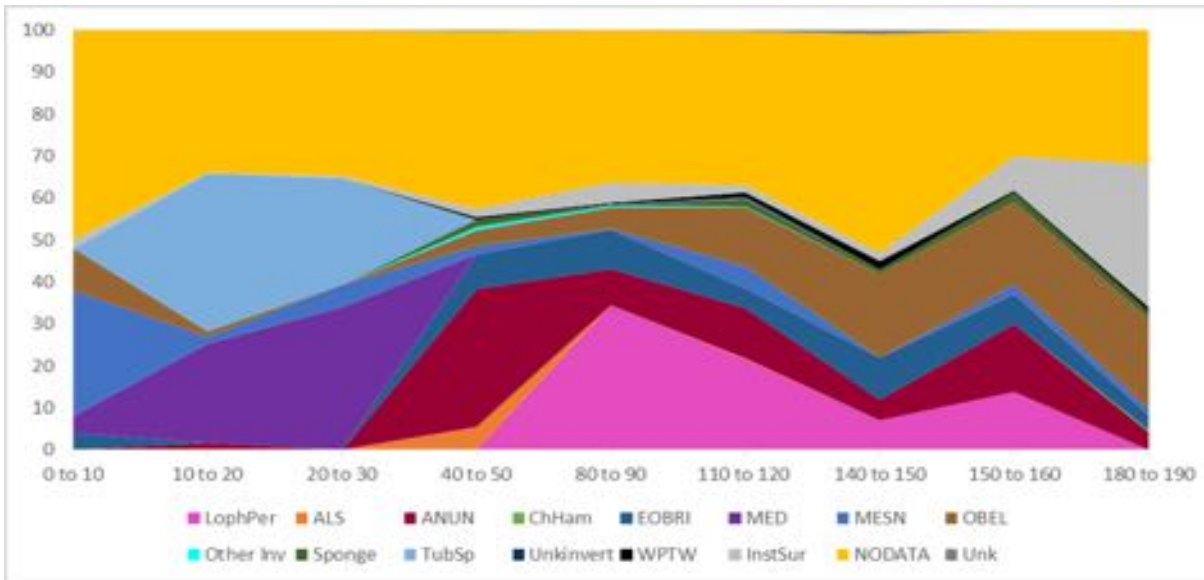


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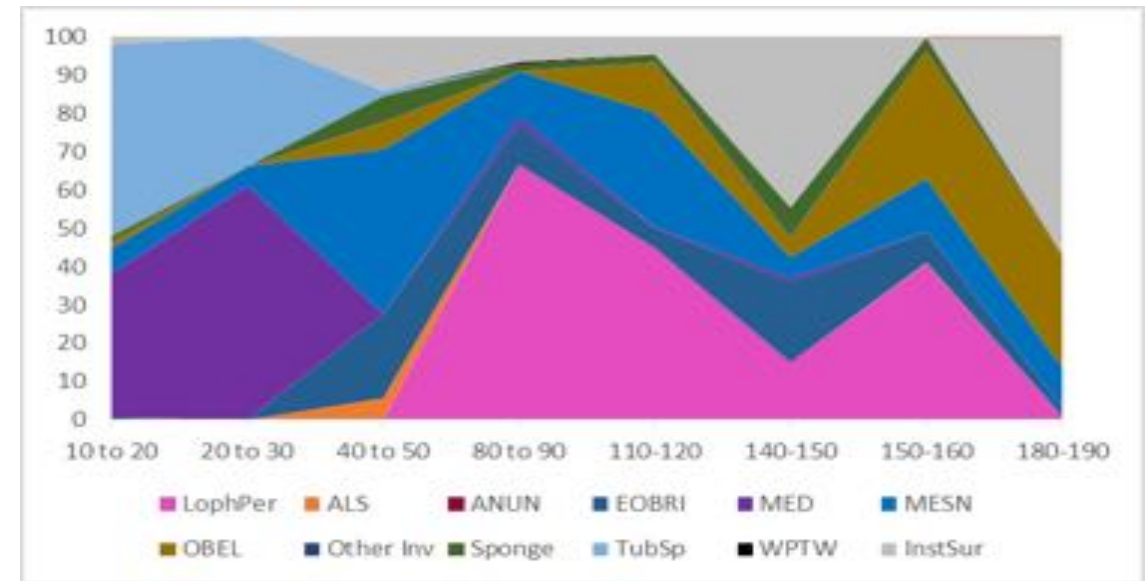
Platform 2B



Unconfirmed

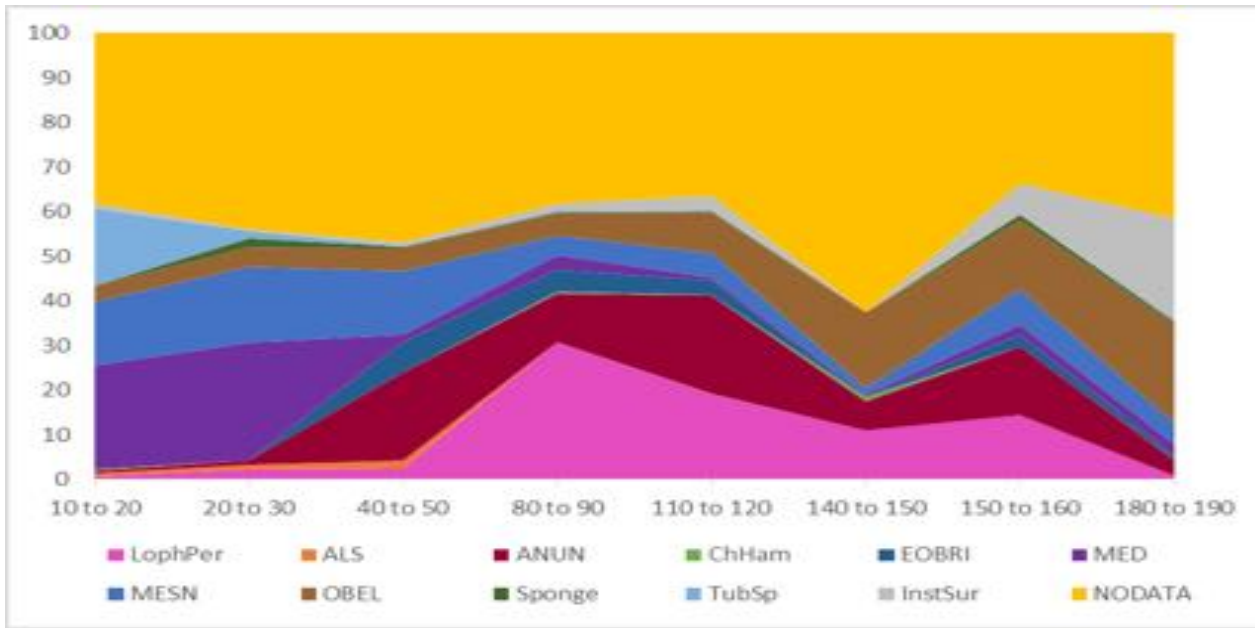


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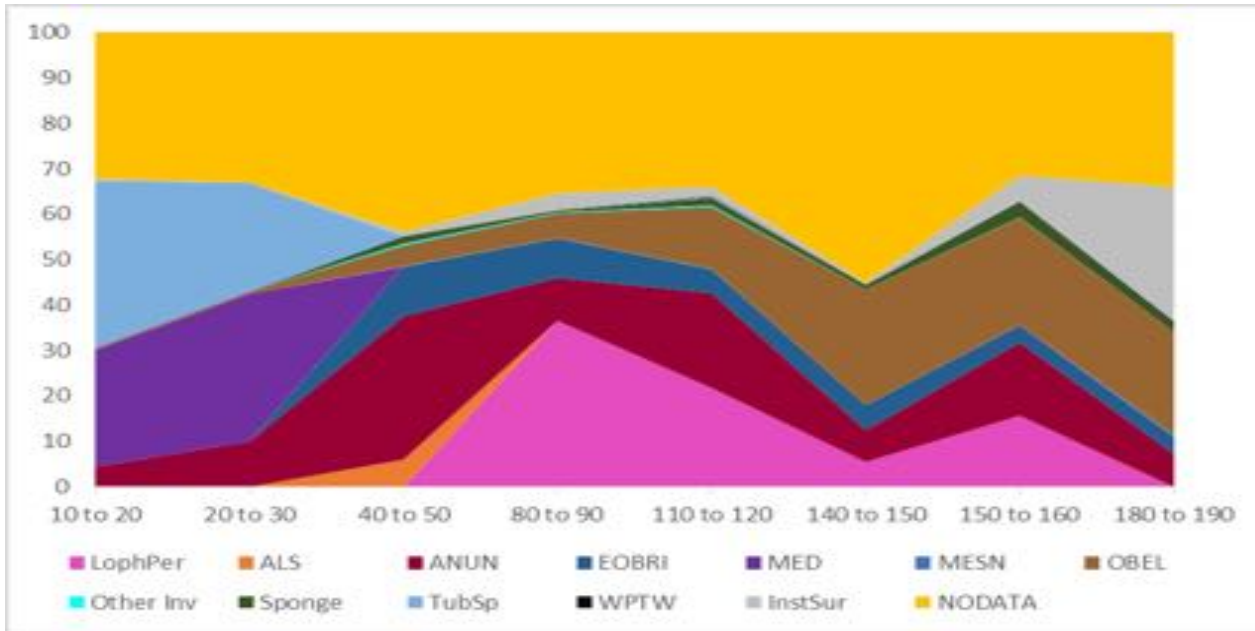


Eye

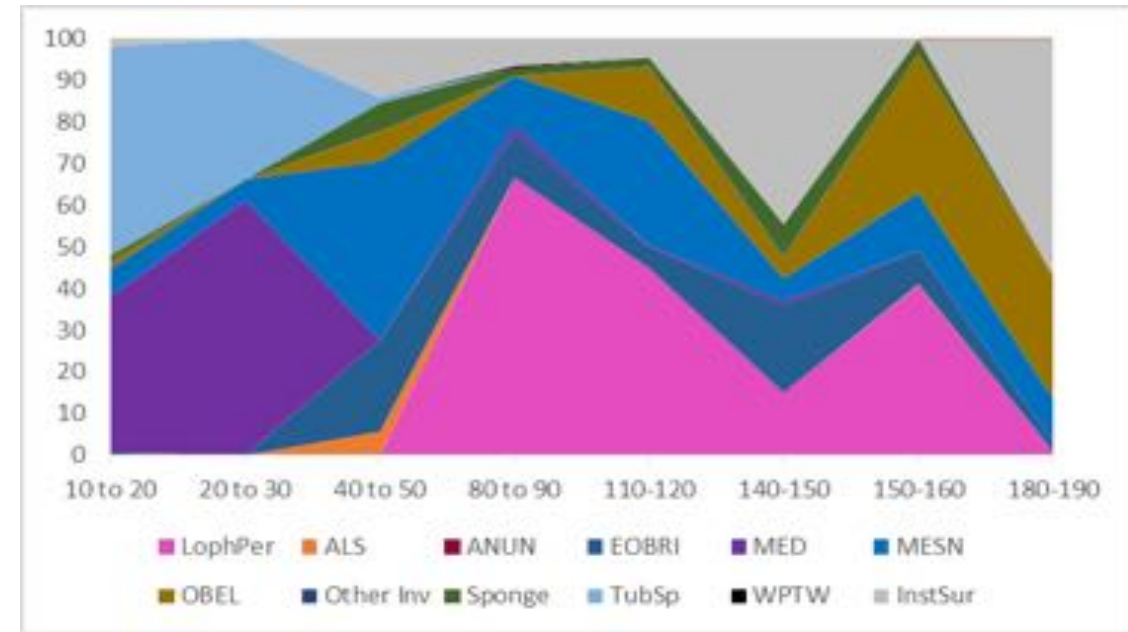
Platform 3C



Unconfirmed



Confirmed



Eye

Results

- Biodiversity – Shannon-Wiener Index
 - Platform 1 – overall LOW diversity, highest diversity at 30 to 40m depth
 - Platform 2 – overall LOW diversity, highest diversity (moderate) at 50 to 60 m depth
 - Platform 3 – overall MODERATE diversity, highest diversity at 150 to 160 m depth
 - Note: not all depth ranges were analysed on platform 3 due to lack of images
- Comparisons
 - No significant difference between testing methods

Limitations

- No. of annotation points didn't seem to have a significant impact of the output on less diverse platforms
- Software only records annotation points, does not extrapolate up across the whole image (therefore, may miss some species)
 - Also, only up to 100% - does not take layering of species into account
- No. images trained did not have significant variety, therefore when tested on platforms with higher diversity, the confidence of the software was lower
- “No data” was not recorded when analysed by eye, therefore has an overall influence on the significant difference
- Quality of images heavily influenced the training and testing classifier
- *Metridium dianthus* and “no data” were the highest number species trained, therefore highest confidence in testing image sets – need more variety of images and species
- At present, no means of making training data available to other projects – this is something CoralNet are currently working on.... Watch this space!

Recommendations to Industry

- When collecting new survey footage, the use of a high definition (HD) video or camera is preferred.
- If using video only, allow time for the ROV to settle at various points on the platform jacket.
- Settle at different locations within 10 m depth ranges, at different orientations and perpendicular to the structure.
- Stay within 1 m of the structure and try to fill the frame with the structure in order to limit “off-structure” areas within images.
- Allow for a minimum of 10 images to be collected from each 10 m depth range.
- Use scale bars or scale lasers as accurate pixel size estimation is critical to the accuracy of the automated system. Ensure that the scale bar is not intrusive to the footage/image and ensure ROV arms or cathodic protection (CP) probes are not within the shot.
- Remove overlay text from survey footage, except for depth; or provide depth details in metadata or image title.
- Where text overlay is removed, the image boundary within CoralNet can be set to X: 10 - 95% / Y: 10 - 95%. Where the text overlay is present, it may be necessary to test the boundary to minimise the chance of points landing on the text.
- It is recommended that 50 annotation points per image should be used, however, this will be dependent on the image quality, the number of rare species of interest and the total number of images taken per depth. This should be considered on a platform by platform basis.
- The annotation point distribution should be set within a grid – either uniform or stratified random (as defined by CoralNet) to ensure no overlap of points and equal coverage of the image.
- Where it is not possible to use images with no “no data”, following analysis, normalise the dataset to remove “no data”

Thank you for your time

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George Gair, i-Tech 7/Subsea 7

Alan Buchan, Wood Group Kenny

Paper: Gormley *et al.*, Automated Image Analysis of Offshore Infrastructure Marine Biofouling, under review
Journal of Marine Science and Engineering, Special Issue: Maritime Monitoring