NAPPN Annual Conference Abstract: Computer-vision based phenotyping approaches in the brown macroalgae, Saccharina latissima.

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Computer-vision based phenotyping approaches have shown to be successful in terrestrial based agricultural crops, however little attention has been paid towards computer-vision based phenotyping in marine based aquaculture. Here, we investigate 2D and 3D computer vision based methods for plant phenotyping in *Saccharina latissima* (sugar kelp). For our 2D approach, we developed a farm-level (20ft row), out-of-water photobooth camera system that captures images of harvested kelp. We then trained a Faster-RCNN model to automatically detect kelp blades. This model output fed into our image processing algorithm to segment each blade and compute phenotyping traits such as: blade area, width, height, perimeter, blade count. Additionally, this algorithm detects blade overlay to identify both blade area and count for blades overlapping in the image. For our 3D approach, we leveraged a revolving camera system and open-source structure-from-motion software to construct 3D representations of individual kelp blades. Using point cloud processing techniques, we developed an algorithm to compute volume (and 2D measurements as listed above). Correlations of this preliminary dataset showed an R^2=0.985, p=2e-16 when comparing computer vision to hand-measured blade length measurements as well as an R^2=0.87, p=2.32e-15 when comparing total area calculated through computer vision against total weight measured by hand. These preliminary results convey the effectiveness of computer vision based phenotyping and the need to increase research efforts in this space.