**Assessment 4.2 – Final Project Submission**

Reef Exploration went through a series of changes with respect to the original version presented in Week 12. Previously, Reef Exploration was a somewhat working prototype of the final product with loaded models, marine wildlife, the underwater vision, and a work in progress time shifting function. It was also clear that the scene required heavy modifications to address the feedback, such as:

* The swimming animations of marine life looking rather mysterious, some swimming backwards.
* The seal animation looked very off.
* The lighting on the corals were overexposed.

There were also some suggestions to add certain features in the scene:

* Make fish go towards Corals and when it becomes night time, have them reproduce and spawn more Fish and Corals as time goes on.
* Have predators prey on other marine species.

The group also recognised some obvious changes that needed to be made, including but not limited to:

* The movement of the marine animals.
* The selector for the time of day.
* The memory footprint of the scene and the absurdly large about of computer storage it requires.
* The loading time of the scene.

Addressing feedback.

* The swimming animations of marine life was the first to be fixed, all models used in the scene were remodelled in blender to face the -Y-axis. This ensured a constant forward-facing standard throughout the models in the scene.
* Seals were deemed not necessary and unfit to live in a marine environment near a Coral Reef, it has since been removed from Reef Exploration.
* The unnatural, overexposed lighting on the Corals were initially implemented to ‘glow’ when Reef Exploration is experiencing the night. The group expected Corals to serve as an alternate light source. It has since been converted to a Mesh Phong Material with no emission.

Addressing suggestions:

* Making fish find their way towards a Coral to reproduce was in our minds since the initial presentation in Week 4 and had been implemented after the Week 12 presentation. Fish will now exclusively select an unoccupied, unreserved Coral and make its way towards it. Once the fish reaches the Coral, it will spawn 1 – 4 other Fish of different species, who will then find their own way to another Coral, and the process will restart.

Addressing obvious changes:

* The movement of non-Fish animals were implemented shortly after the Fish-Coral functionality. Non-Fish animals will rotate 0 – 359 degrees on the +Y-axis and then -5 – 0 on the +X-axis. Afterwards, the respective animal will move in its +Z-axis, in object space, to mimic movement.
* Selecting the time of the day was a big issue using a Directional Light, as the light rays are cast orthogonally, we needed shadows to be cast on everything. The Directional Light that previously lit up the scene was replaced by a Point Light to shine at an intensity of 1, at a distance of 1536 units (astronomical units, scaled to Reef Exploration size) away from the terrain which casts light and shadows all over the scene. The new Point Light will move 1 astronomical unit away from the surface at a rate of .01 units per second by default. The user can now change the time scale of the scene with a GUI controller. As a result, Reef Exploration can now imitate the sunrise/sunset and solstice colours of the sun ray’s refraction with Earth’s atmosphere, producing a picturesque sunset or sunrise. With newly added fog to the scene, and now the colour of the sun, Reef Exploration looks more realistic than before.
* Before Week 12, Reef Exploration’s root workspace had a displacement of approximately 350 megabytes. This was due to the entire THREE.js library. This may have been a cause for the extremely long loading times. There have been multiple mass deletions of unnecessary files that reduced Reef Exploration to 45 megabytes.
* Previously, Reef Exploration took between 30-1 minute to load. While being really difficult to test new functionalities, the group decided to optimise the project through refactoring and removing any unnecessary code as well as many inefficient or duplicate lines. At present, Reef Exploration takes approximately 15-30 seconds to load.
  + Tested using averages from Visual Studio’s Live Server, Atom’s Live Server and Microsoft Visual Studio IIS Express ASP.NET over 3 runs with Ryzen 9 5900X.