Procedural Tools Example: Open World Manager

For one of my prior jobs I created this complex tool and I will explain it in the following. The underlying pipeline was a procedural world generation, where we would create hundreds of configuration files. The most basic type would define what objects are placed under certain circumstances, the configuration object layer on top would define Sub Biomes (so to say group the objects), then there would be biomes (which would group the Sub Biomes) and in the end maps, which are collections of biomes. This workflow would allow numerous people to work together at the same time, setting up the biomes, painting them out (size, density, growth and type) without having to think what should be placed or how many. But it came with one big downside: a huge amount of setup overhead and the connected complexity to manage it.

The tool I'm going to present here had the following requirements:

- know about all setup files without the user pointing it to it
- search through all files based on numerous criteria
- add, remove or create setup files
- multi-object edit those setup files
- check for sanity of those setup files
- full perforce support

Along the way a stretch goal appeared that overall fit logically quite well into the tool, even though it was quite different from the remaining functionality: placing VFX and Audio in the world. Here are the major requirements for this sub-tool:

- place audio and particle system based on the properties of the placed mesh, e.g. falling leaves VFX with every tree of a certain size
- avoid large quantities of actors
- allow for controlled spacing between audio and VFX emitters, e.g. every 100m one emitter
- communicate the placed objects information about the mesh, type of tree or size
- allow for manual placement of the audio / VFX emitter, e.g. bird audio sound on top of the crown or ant VFX emitter on the bottom of the grass

Here are some general thoughts when I got to know about all those requirements:

Due to all the different functions, I chose a tabbed layout. It allows for good categorisation and is very flexible in case more needs to be added. There will be a lot of buttons involved, color coding them is an excellent way to guide the users' eye. I chose the following concept:

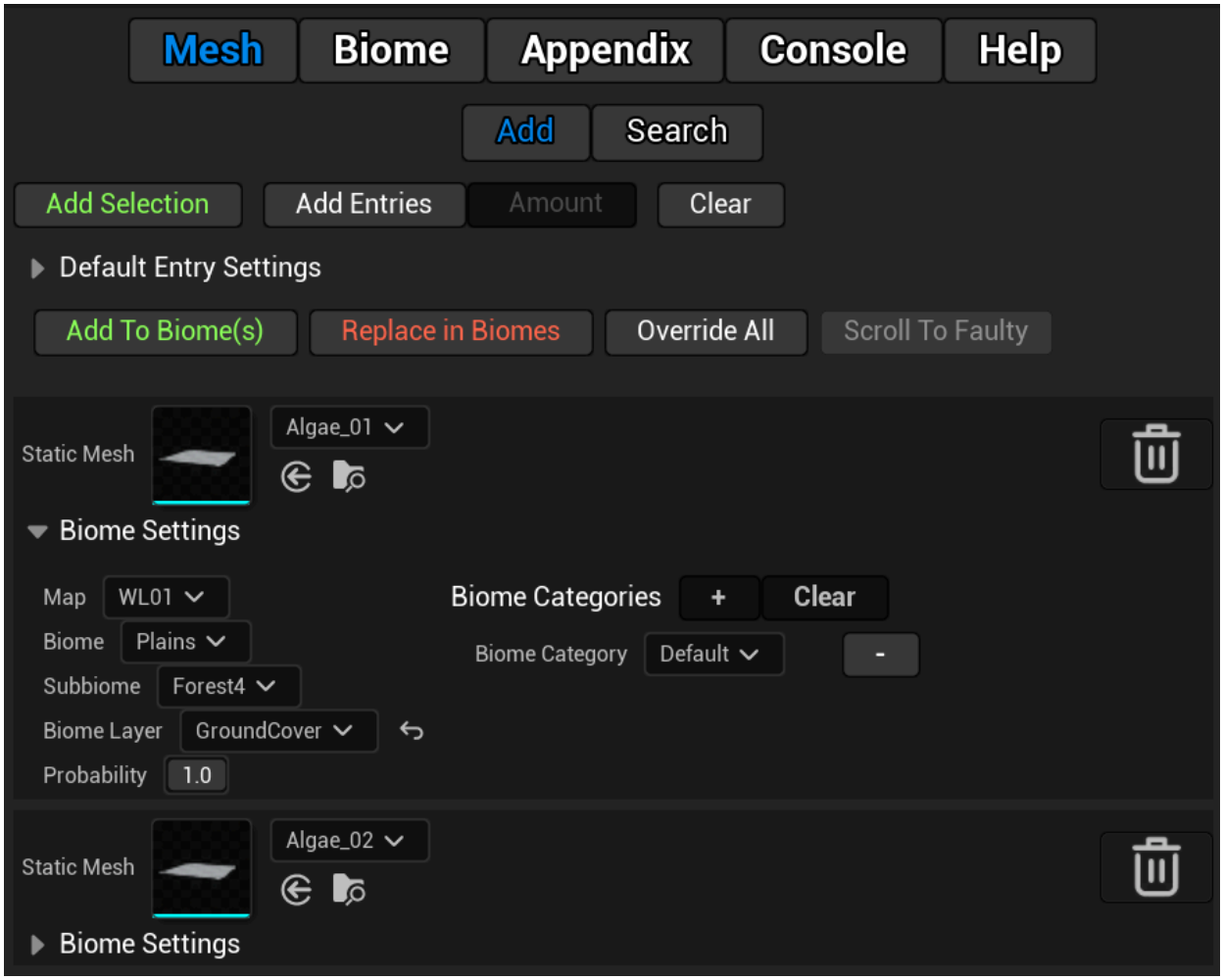
- blue: chosen tab highlight
- green: non-destructive action
- red: destructive action
- pink: lengthy non-destructive actions
- white: inactive tabs and support / setup buttons

To avoid lots of scrolling through the lists, I added wherever I saw fit auto scrolling functions.

Such a large tool will have an incredible amount of potential errors. So to make the user aware of those more conveniently, I wanted to add its own console, including export and filtering functionality to help the Tech Art department to track down issues.

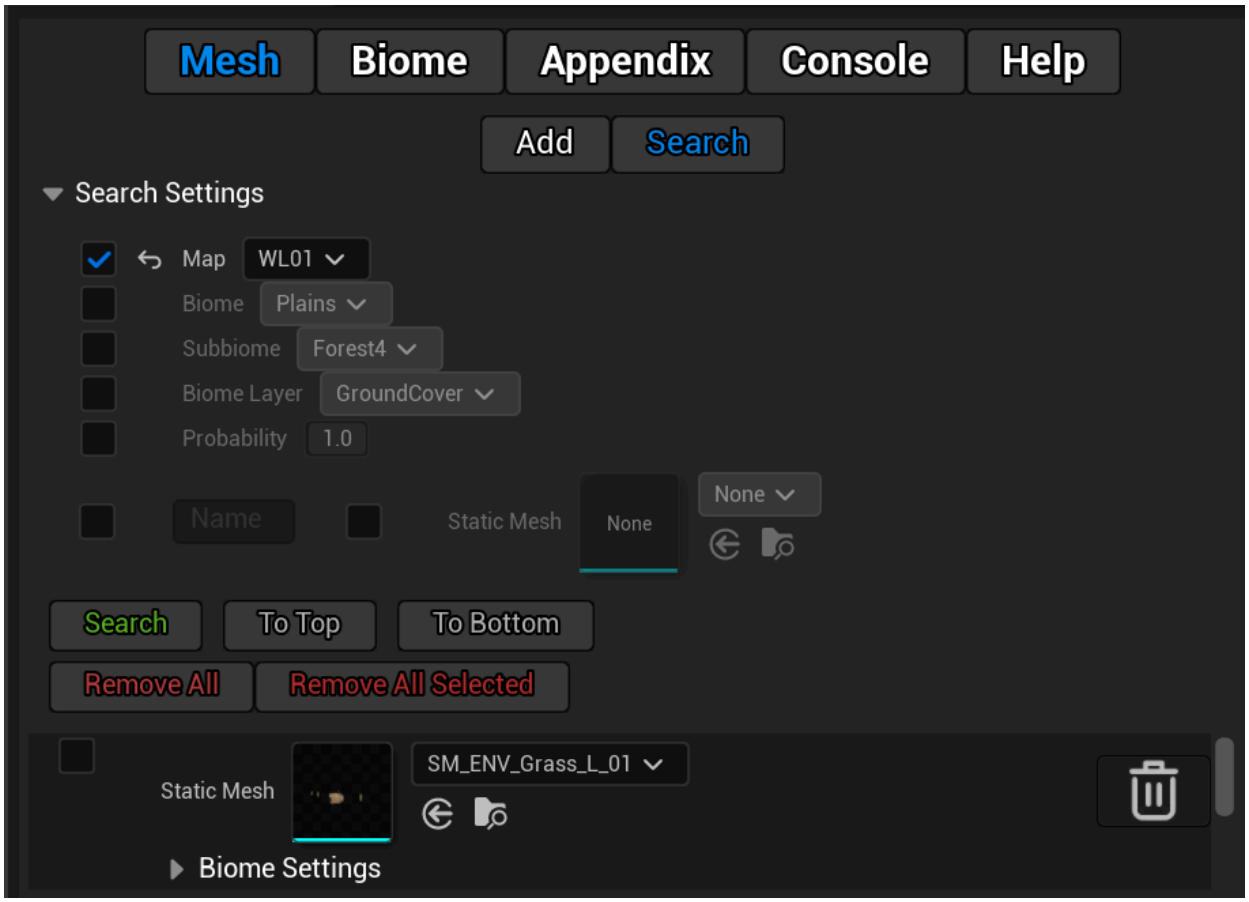
Adding new meshes to the system

This section allowed for selection of any mesh in the content browser to be able to assign it conveniently to any biome setup. ‘Faulty’ setup like missing setup, duplicate categories or 0% probability would be highlighted and auto-scroll was added.



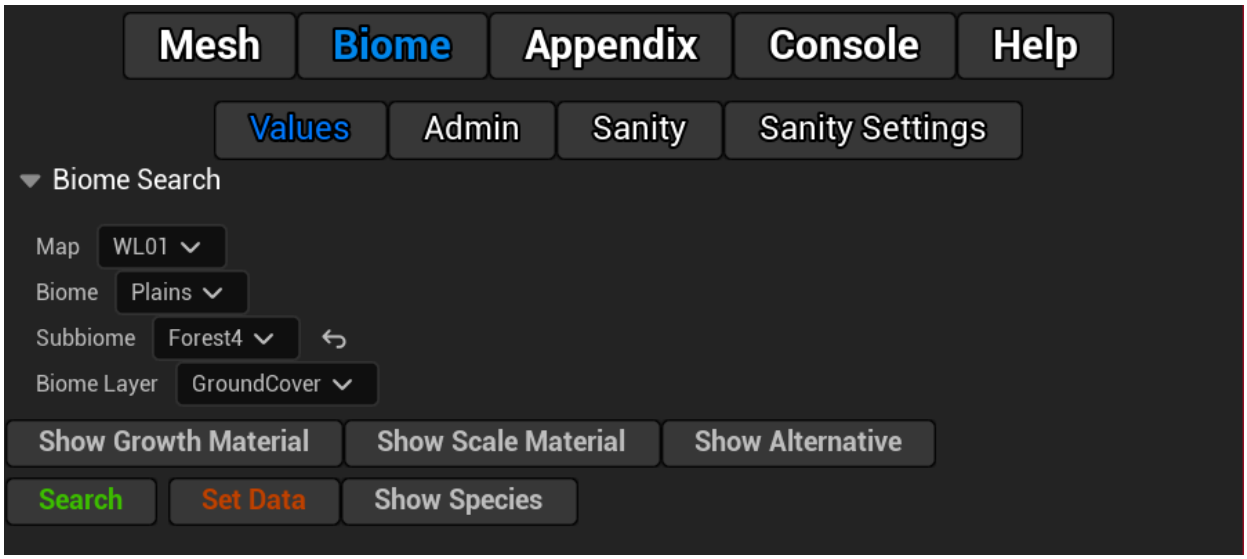
Searching for existent meshes

Search functionality would allow for any type of property to be looked for. The found setup files could then be highlighted in the content browser or deleted in bulk as well as moved to a different biome.



Biome Values

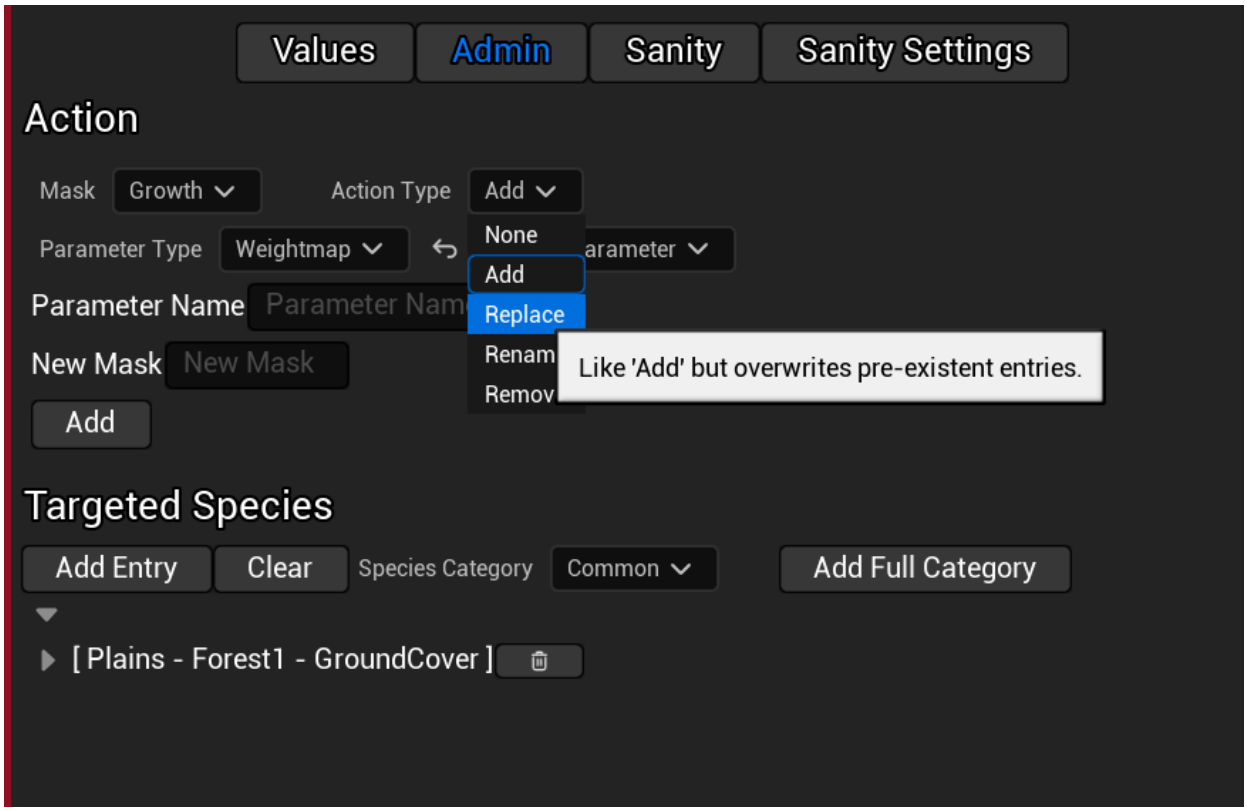
The values tab allows for checking any setup of a settings file. Every properties file had three different masks, one for its growth (is it getting scattered?), scale (what size should the scattered object have?) and alternative (should it be a dry version of the same biome or maybe snowy?).



Due to the nature of the system, there were a lot of duplicate properties (different masks depending on the same noise settings for example). This tool merged them into one entry but when set, would always override every similarly named entry altogether, avoiding lots of human error in the process.

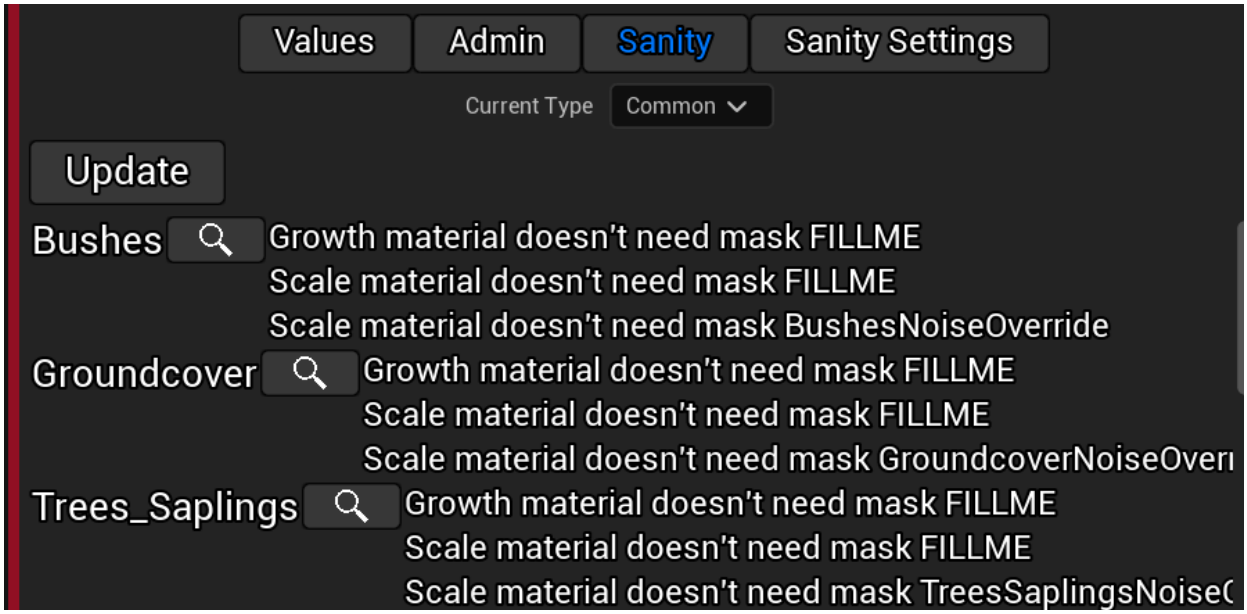
Biome Property Controles

This area allows for interacting with existent / new parameters for any singular or set of settings objects, allowing for quick multi-object-editing which would otherwise be not as convenient.



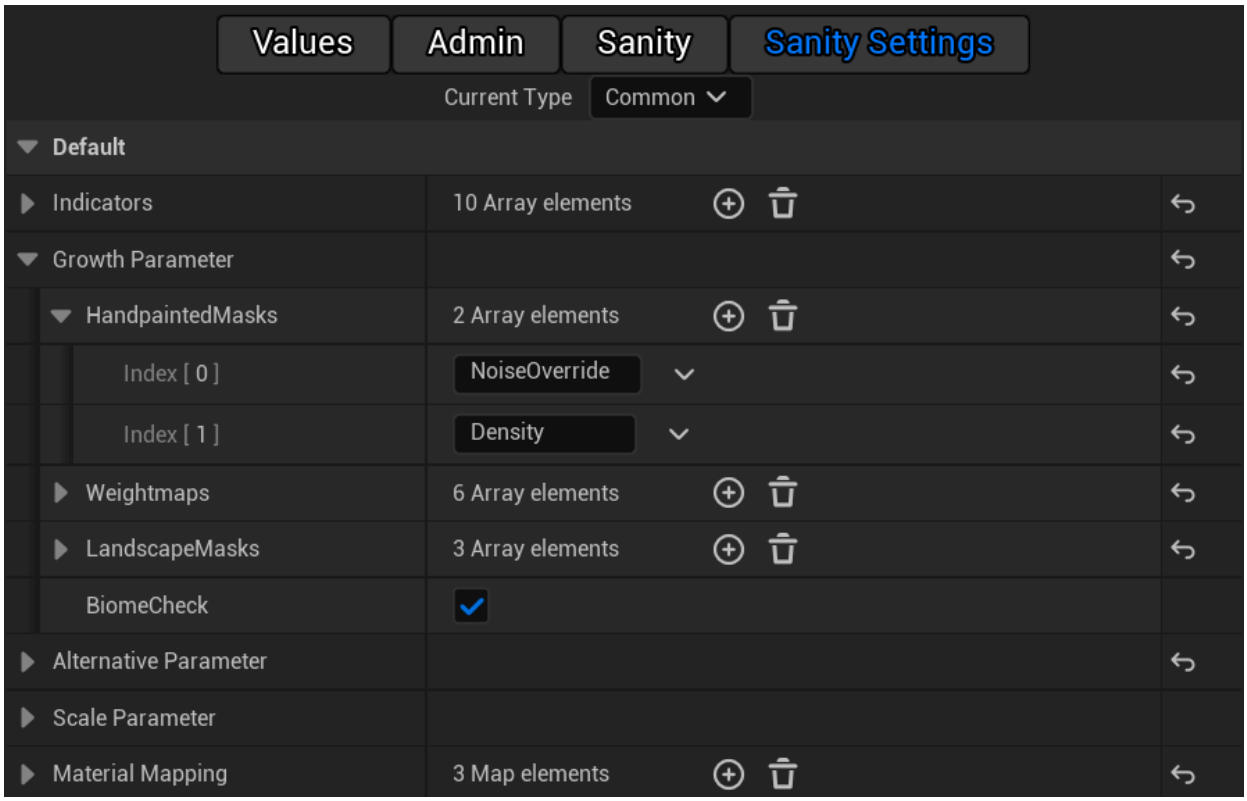
Biome Sanity Checker

Since the whole system depends on massive amounts of properties which by default would need to be added manually, this tool points out exactly which ones are missing. Naming was the most crucial part, so it would not only point out missing properties but excess ones as well. Maybe there was just a typo.



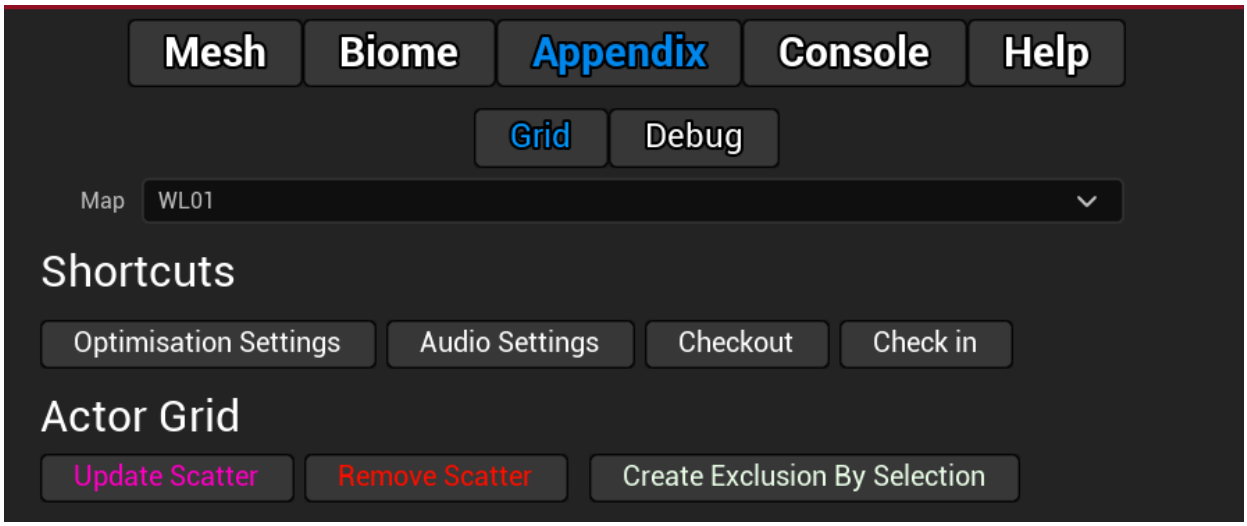
Biome Sanity Settings

The biome sanity settings contained all the naming parameters, important settings and any other general logic for the system to make sure it exists.

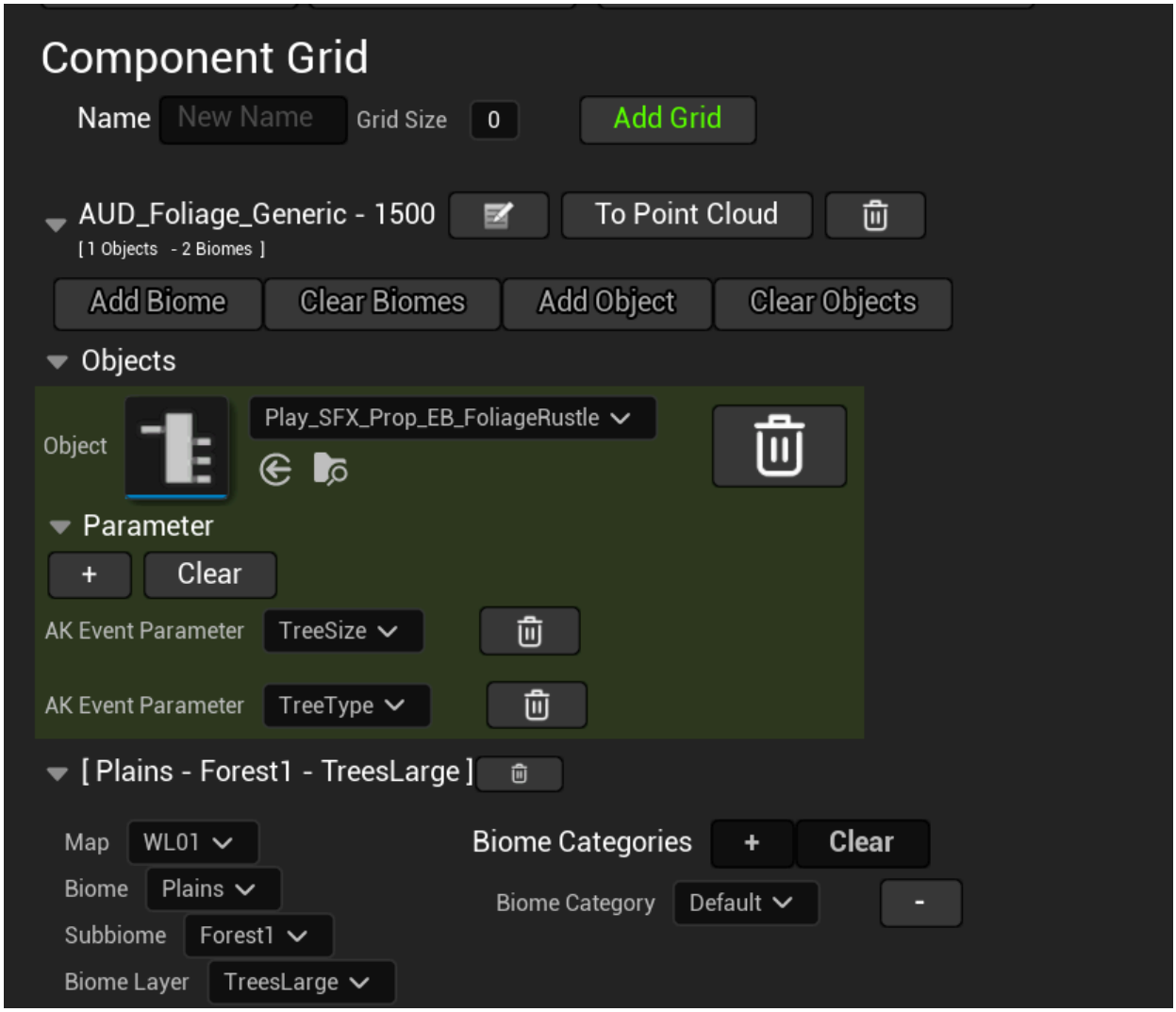


Creating appended components

The idea was to set up differently spaced object grids, where based on the properties defined in the optimisation and audio settings, the user could define that, e.g. every 10 meters there would be a bird and every 50 meters the bird sound. This was Implemented in a very lightweight way with a kd-tree in python, easily allowing point clouds of 20 million plus in around a second of computational time.

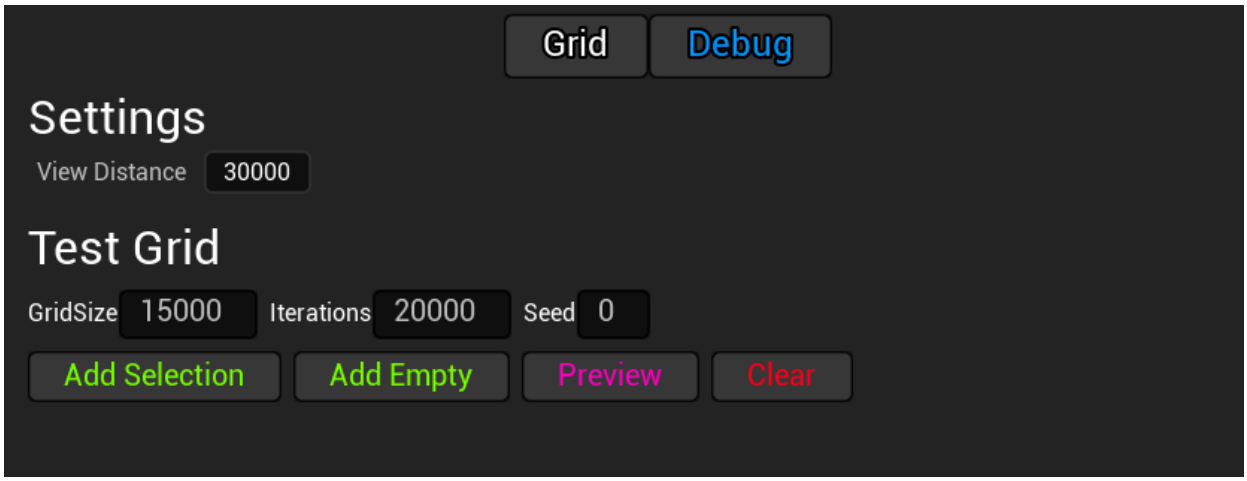


A grid had not only a name but could be assigned Niagara systems as well as AK Events (this would accept any type of assets. Supported assets are highlighted green). Every of those Objects could be assigned numerous parameters. In this example here, the TreeSize and the TreeType. In the audio settings, it is defined that a tree of 10m would be considered ‘Medium’ and that would be passed to the AK Event to choose the correct sound. The distribution of those objects is determined by the chosen setup, as shown in the bottom with Map, Biome, Subbiome etc. ‘To Point cloud’ would convert the current setup into a debug point cloud and visualize it.
In the end those components would have a secondary grid that would define the bounds of the actor and would automatically add the components. For example every 10 meters there’s a bird sitting on a tree. If the actor has a grid size of 100m, then 10 x 10 niagara components would then be added to it.



Debug Settings

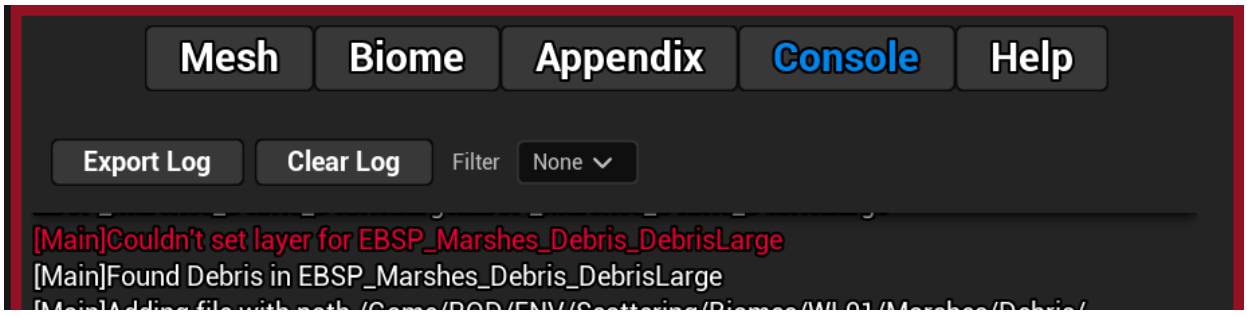
In order to have a clear idea about the spacing, a debug view was implemented. This would draw debug shapes in the viewport to showcase what that seed and grid size would look like based on the provided meshes.



The preview result would look like this. The filtered instance would be highlighted in the viewport and could be adjusted to the user content.

Console

The console shows a colored frame based on the most critical type of error that occurred. Filtering and clearing allowed for changing the amount of visible entries, export would create a text file. When the tool would be closed or crashed, this log would be sent to the UE5 internal log.



Help

The help button leads directly to the Confluence documentation.

Structure

The overall UI consists of more than 30 sub-widgets and more than 100 structs and data asset types to allow for a very much customisable experience. This tool is 60% Blueprint, 30% C++ and 10% Python. It ended up having more than 20 pages of documentation and allowed for 15-20 people to create an open world simultaneously without much training time. Overall time to create including lots of feedback was around 3 months.

There’s an incredible amount of things that were not mentioned due to the sheer size of the overall tool. If you have any more questions, I’ml be happy to answer!