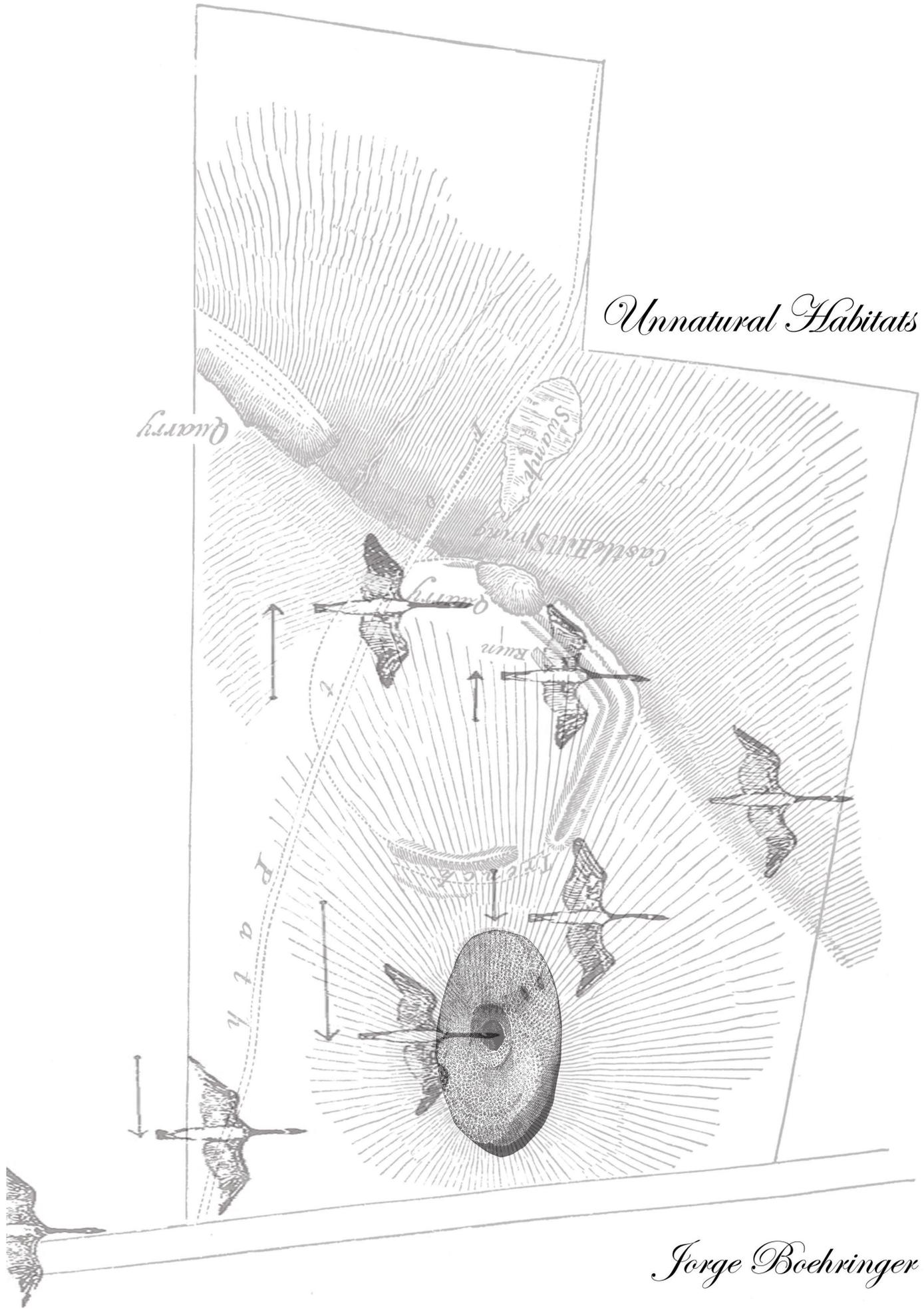


Unnatural Habitats



Jorge Boehringer

Unnatural Habitats is a piece of real-time electronic music for computer and performer. The duration of the piece is 26 minutes.

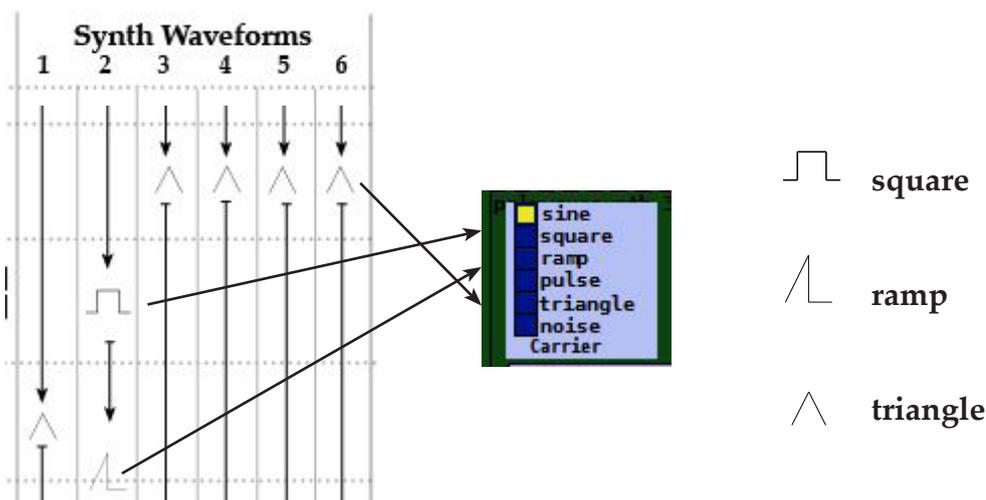
The performer enacts the piece by starting and ending musical processes, or through the introduction, alteration, or removal of the sound material that embodies these processes. These actions are performed using the interface pictured below and the score attached.

I. The score

The score is two pages long. Vertical position on the score represents the passage of time with earlier actions occurring above later ones. Numbers running down the left hand side of each page designate passing minutes, beginning at zero and ending after the completion of the 25th minute, shown on the lower left of page two.

Columns stretching across pages from left to right provide performance instructions as a list of ordered events (“ACTIONS”).

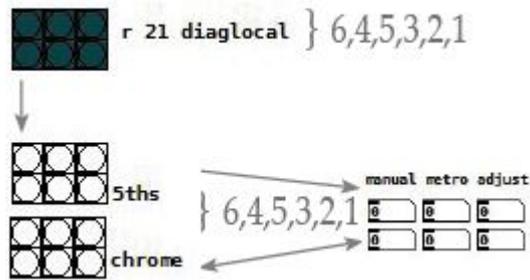
Graphic symbols are used to notate where on the instrument the actions specified in event should be played. Six smaller columns on the right half of each page are labelled Synth Waveforms. These columns refer to the “Carrier” waveform portion of the synthesizer rather than sequencer interface. This is where a performer alters the type of wave shape that is synthesized in the production of the sound.



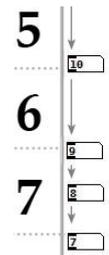
The piece begins with randomized behaviour applied to both the synthesized wave and a second synthesized wave modulating the first, however, as the piece progresses the performer takes control of these waveshapes and alters them in the manner specified reading downward along the Waveform 1-6 columns in the score. The key to how waveform diagrams map to names on the synthesizer are given in the diagram above. In this piece, the performer only manually activates the triangular, ramp, and square waveforms.

As stated, vertical position on the score represents the passage of time. Thus, actions closer to the top occur before those occurring lower down. Where the density of events makes the order of operations confusing, arrows connect subsequent events.

Two-headed arrows designate situations in which a performer controls two parameters at once, or bounces between them. This is the case, for example, in minute 24 where the performer repeatedly alters the chromatic identity of the modules and gradually expands the clock that controls the sound generation of that module by turns.



Events notated on the border between two minutes, as shown below, may occur anywhere on or near the cusp of the changing minute.



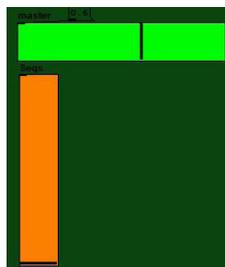
With the exception of those given above, graphic symbols used in the score are identical to those used on the interface of the instrument, discussed below.

II. The Instrument

The instrument for performance of *Unnatural Habitats* is designed in the computer programming environment Pure Data (Pd) and so some knowledge of this computer music system is helpful, though not essential, to preparing a performance of the work. It is necessary to install Pd on a computer and have it running to perform the piece, and details on how to install and configure Pure Data are given after information specific to this piece itself.

A. Anatomy and Control

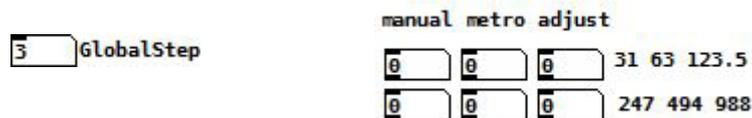
The instrument for performance of *Unnatural Habitats* consists of four main parts, each of which is pictured, and discussed in turn.



The image at the bottom of the previous page shows a set of controls for sound volume. The top, horizontal control is preset to the level seen in the image above when the patch is activated. This controls the overall volume of the piece. The vertical control, labelled “Seqs,” controls volume for all the sound produced in the patch within the range constrained by the master volume level set above. Seqs is used for the gradual fade-in that begins the piece.



Above is the control module, allowing performer access to the bank of six sequencers running in the background. This module is where the patch is initially activated from the red **global** button in the upper left corner of the patch. It is also where one finds the “global_step” control and “manual metro adjustment” shown below.



These two controls are used in several places in the piece. **Global Step** allows for all six sequencers to be set to a single number of total steps in performance of their sequences. The **manual metro adjustment** tool alters the rate of step of the individual sequencers. The top three number boxes represent sequencers 1-3 and the bottom representing 4-6. This is a convention maintained on all modules in this patch. The score uses this nomenclature when a specific module or order of modules is called for in a particular action.

1 2 3
4 5 6

The numbers to the right of the manual metro adjustment control give the starting values for the metros for reference, as the performer must enact gradual and individual swells and deviations in the step rate for the individual sequencers during the second half of the piece.

In the center of the control module pictured above are buttons that apply processes of diagonal metamorphism to the material being sequenced by the six sequencers. Diagonal metamorphism is a permutative process of transformation and layering in which musical parameters abstracted from sound material are recombined according to sequences having their own logic. These are then fused to form the final sounding result. In this piece the sequences of transformation, as in the sequences of pitches, are composed and available to the performer as presets. However, the performer controls when they are applied and this has a definitive effect on the result of the created texture.

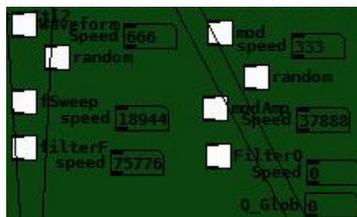
From the center of the diagram above and moving left to right one encounters transformative presets for register (octave) transformation of the sequences, followed by alterations of pitch in the form of transposition by 5ths and semitone accidentals, followed by pitch and volume randomizers. The last are not used in this piece, but are in other work with this instrument.

From top left, “2Hi” increases the upwards registral reach of the sequenced pitches by two octaves. Similarly, below this, “2l” and “r1” lower the register reach by two and one octave respectively. The buttons next to these labelled “default” in most cases returns these to their starting values. Moving to the right of these modules the “5ths” and “Chrome” buttons apply transformations by fifths upwards or downwards, or half-step accidentals, applied to each step in a sequencer respectively when clicked. The upwards or downward direction of movement of these is randomly chosen. Repeated clicks results in interesting behaviour, and the “chrome” control is triggered repeatedly towards the conclusion of this piece.

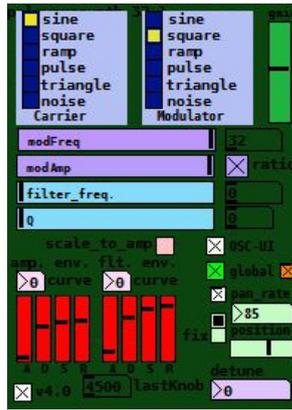
Performers are encouraged to explore the functionality of all of the modules in practice (to include those not used in this piece if they wish). The control module contains a suite of tools for troubleshooting, refreshing, or restarting aspects of the program during performance if needed. In general, this blue section, pictured below, is not used in the piece, unless software issues arise. In between practice runs of the piece, or should problems be detected before the piece is begun, it is recommended to close the patch or all of Pd and begin afresh rather than attempting to reset defaults with this blue panel.



The “panic block” above contains buttons that, if clicked, reset the global step value to either 21 or 1, followed by controls to reset pitch, volume, register, accidentals, and chromatic sequence settings to initial values (pvrs5ch). Below this is a button that initializes metros, one that sets pitch to default values and one that does the same for volumes.



The small interface pictured above is coupled to the synthesizer pictured below. There are six of such pairs and, whereas the control module pictured on the opposite page creates longer-term sound behaviours, these modules generate the sounds themselves. The module above is used in this piece to turn on and off processes and randomization of processes. These processes and randomization are applied to synthesized carrier waveform, modulation waveform, speed of modulation, amplitude of modulation, and filter frequency, as seen in the image above.



When opened for performance, the patch automatically loads six instances of the synthesizer pictured above and the small interface attached to it. All settings for the performance of this piece are preloaded and the only aspects of the synthesizer interface that a performer uses during the performance of *Unnatural Habitats* are the Carrier and Modulator Waveforms, and the four horizontal sliders in the center of the interface surface. This synthesizer is a modified version of a design by composer and inventor Phil Stone, and performers are recommended to explore all of its functionalities during practice.

B. The Instrument 2: Control Pure Data Objects

With Pd in performance mode (see below) the performer makes their way downward, through the actions in the score, always listening and proceeding very gradually. There are three main pure data objects performers must know how to activate to begin, end, or alter processes or materials in this piece.



The above pictures a “toggle” in both active and inactive mode. This toggle happens to be the one used to turn on and off the main performance patch and run the piece. However, it functions in the same manner as the slime green toggles to its right in the control module. These turn on and off each sequencing module individually and feature prominently in the closure of the piece.

Toggles function simply: click to activate an “X” that fills the toggle. Click to deactivate and the “X” disappears indicating that the process is inactive.

Buttons pictured below activate processes in Pure Data and may be repeatedly activated. In the score, performers are asked to activate some multiple times, and others only once.



Number boxes, pictured below, allow for numeric input. Clicking and typing a number into a number box, then pressing return enters that value directly. This is the method of performance used for the number sequences in this piece. Number boxes with values in them may also be clicked and dragged up and down in value with the mouse. A combination of these input methods are used with the manual metro adjustment tool.

III. Performance Space and Equipment

In addition to performer, score, computer, and Pure Data, the piece requires a sound system capable of substantial volume, a simple mixer with a channel strip for equalization, a stopwatch, and a performance space.

The piece should be played loud. While volume should not be painful or dangerous for listeners, it should be loud enough to provoke response from the acoustics of the performance space and to be felt physically. It should feel extremely full and immersive for audience members once the maximum dynamic for the piece is reached at 2'00." Therefore, a full spectrum, balanced sound system capable of significant volume is needed for performances of this piece.

A mixer should be placed between computer and sound system. This allows a performer to mediate emergency situations in case the computer or electronics produce unexpected behaviour. It also allows for a master gain control to the volume controls already present in the patch, this one useful for directly addressing the sound system. A mixer with an Eq control or channel strip is required as the performer will make real time adjustments to the Eq of the sound being produced in the course of performance, as discussed in the next section.

The performer should activate the patch, silently, a minimum of 0'30" seconds prior to the start of the performance. This allows the randomized parameters at the beginning to initiate their own trajectories.

When the performer determines it is time to begin, they activate their stopwatch, and begin the score at 0'00" with the patch already running. The first action is a very gradual crescendo in which the sound slowly arises. The performer should listen very carefully during this process and adjust the EQ on the channel strip to enhance emergent patterns or structures. When the maximum volume for the piece is reached 2'00" into the score, this volume is left in place for the rest of the piece, dynamic variations from thereon being a function of density, waveshapes, and harmonic activity.

The performer may sit anywhere, and the middle of the audience or in the middle of the room is recommended. The best seating arrangement allows the performer a balance of resonant room sound with the sound broadcast from the loudspeakers.

The piece consists in the experience of listening, rather than simply the output of the synthesizer. A performance over headphones is therefore partially antithetical to the intention of the work. It is recommended that recorded performances of the work are listened to over loudspeakers and adjusted to a volume that resonates their listening environment. In practicing the piece, volume levels should be adjusted to bring out room resonances that the performer can work with while rehearsing. Every complete realization of the piece in the appropriate conditions described here constitutes a performance, even if the performer is the only audience member present.

IV. The Role of the Performer in *Unnatural Processes*, and Rehearsing the Piece

The task of the performer in *Unnatural Habitats* is to enact sounds and processes given in the score in a manner that encourages an emergence of patterns and structures beyond those individual sounds and motivic fragments that are output by the instrument. Such emergence occurs due to interaction between the produced sounds themselves, interactions between sounds and the resonant environment, and interactions between sounds and listening minds. A performer's response to sequences and patterns that they hear in the complex web of broadcast sound, along with their response to the changing acoustical dynamics of sound in the performance room, function to foreground these emerging structures.

Therefore, it is essential that performers train themselves in two ways in preparation for the performance of this piece. First of all, a performer must become familiar with both score and instrument. It is useful to know what sorts of sounds the instrument can produce, and the specific types of sounds a performer will create with the instrument in this piece. In the score, time is depicted as progressing downward, and the general order of events is given by minute. However, *exactly* when actions take place is often at the discretion of the performer. A performer's response in accelerating or holding back the notated material can encourage or discourage the formation of pattern or structure. As practice will reveal, the order in which the sounds are presented changes how they are heard.

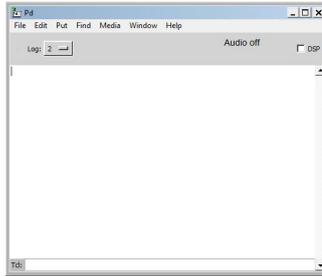
Accordingly, the ability to aurally recognise structures and patterns as they emerge is crucial to this piece. The piece creates conditions for several types of pattern formation and structural emergence. It is important that a performer is perceptually attentive to the development of these phenomena, in order to foreground and encourage them. Facility with active listening can be developed through practicing this piece, but also through active and dedicated listening to environments, room resonances, and the sounds of their own bodies and minds. A useful practice is to sit with eyes closed, or nearly closed, for twenty to thirty minutes a day, redirecting one's attention to sounds as they are heard, while suspending discursive operations and internal dialogue.

In the course of performance emergent structures and patterns are emphasized and foregrounded through careful timing of purposeful action applied at the instrumental interface, along with with fine adjustments made to the outboard equalization control on the mixer. Such small changes in equalization can function to bring aspects of the harmonic spectrum into focus or suppress other parts, and can also function to enhance or discourage room resonances contributing to, or interfering with, emergent structures. Rehearsed familiarity with this powerful tool is therefore essential.

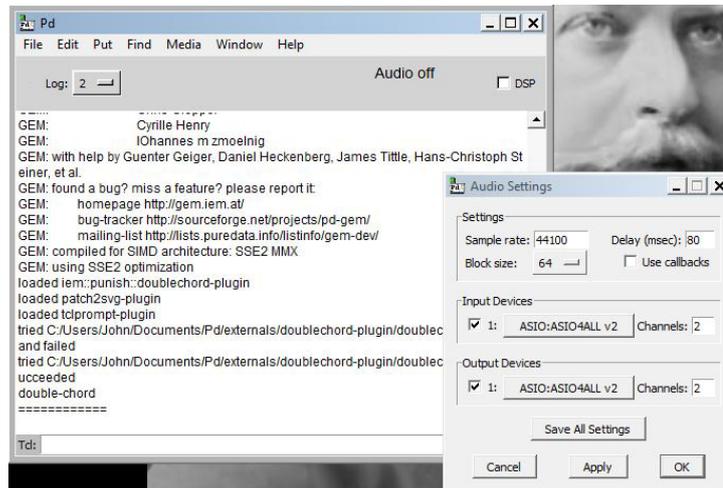
For rehearsal, each practice space should be treated as a performance space with the performer at a location in which they will hear resonances that emerge from the interaction of synthesized sound and sympathetic room reverberation. Loudspeakers should be adjusted to a volume sufficient to achieve this during rehearsal sessions. When practicing this piece, I find it helpful to consider every enactment of the piece a performance.

V. Installing and Configuring Pure Data

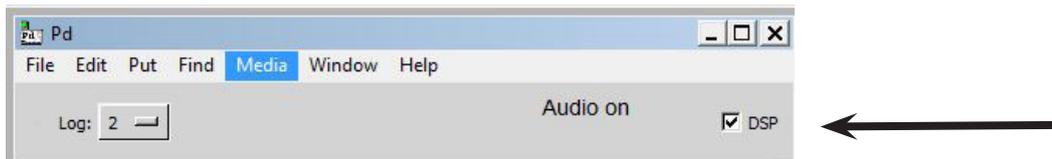
After installation open Pd. The window seen below is displayed.



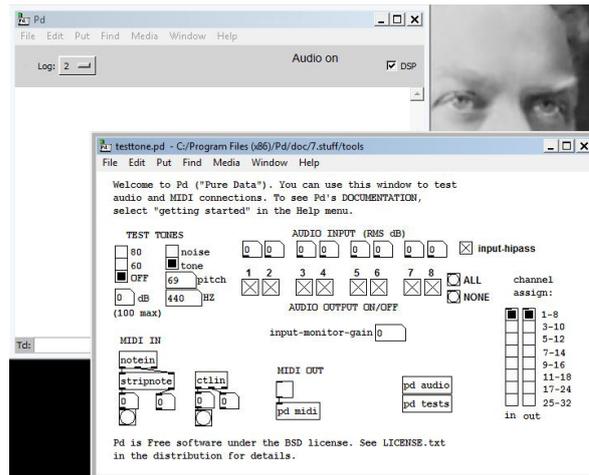
The first thing to do is configure the sound output and activate DSP, so that sound can be output. This is done by navigating across the top of the Pd window shown above, clicking the Media tab and selecting Audio Settings from the dropdown menu. The window shown below appears.



Only "Output Devices" is important for the purposes of this piece. Simply click the output tab and select the sound output system that you wish to use to get sound out of your computer. The number of channels should be set to "2" as this is a stereo piece. The rest of the default settings should be fine for performance, so click "OK." Now tick DSP in the small right tick box on the Pd Window as shown below.



Pure Data has a built-in functionality that allows you to test the sound configuration. Navigate to the Media menu as you did in the last step, but this time select "Test Audio and Midi" from the drop down menu. The program shown below opens.



Click the 60 or 80 below the label "TEST TONES" in the open window. These numbers represent volume levels so be careful clicking 80 if your speakers (or worse, headphones) are turned up too high! If sound is heard, you have configured everything correctly. If not, repeat the steps above, and if still no luck seek professional help.

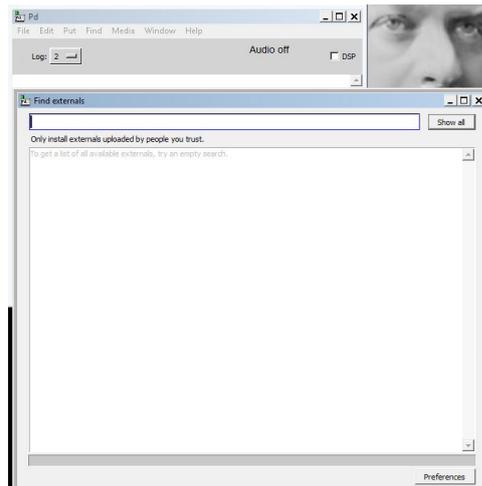
The next step is to load the program that will run the piece.

Programs in Pd are called patches. The patch that runs the synthesis system used to play this piece lives in a folder with all the small bits of programming that are needed to make it run. It is called "UnnaturalHabitats_PERFORMANCE." From the "File" menu in the Pd window, select "Open" and navigate this file on your computer. Click "Open" in the browser window and the patch will open.

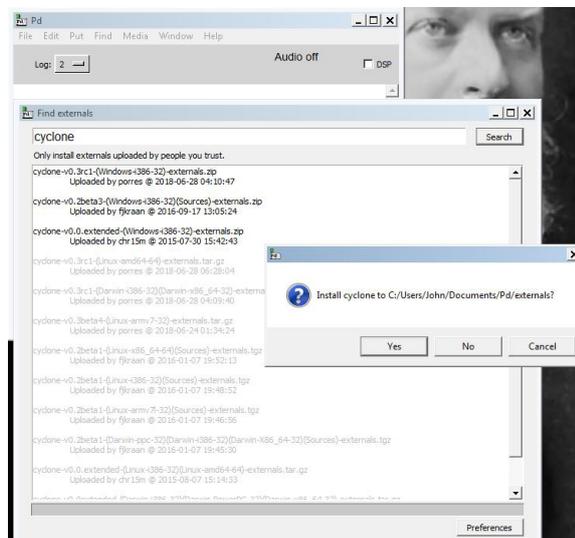
Pure data has two cursor modes, and performance mode and an edit mode. To activate and perform the piece, it is desired to remain in performance mode throughout. This can be selected in the edit menu from the Pd window or by clicking ctrl E on windows or cmd E on mac. In performance mode the cursor appears as an arrow, and aspects of the patch can be clicked on and off. In edit mode the cursor appears as a hand and aspects of the patch can be opened and moved around. Doing this in your performance copy of the patch is not recommended as it may prevent the program from running properly!

Installing Libraries

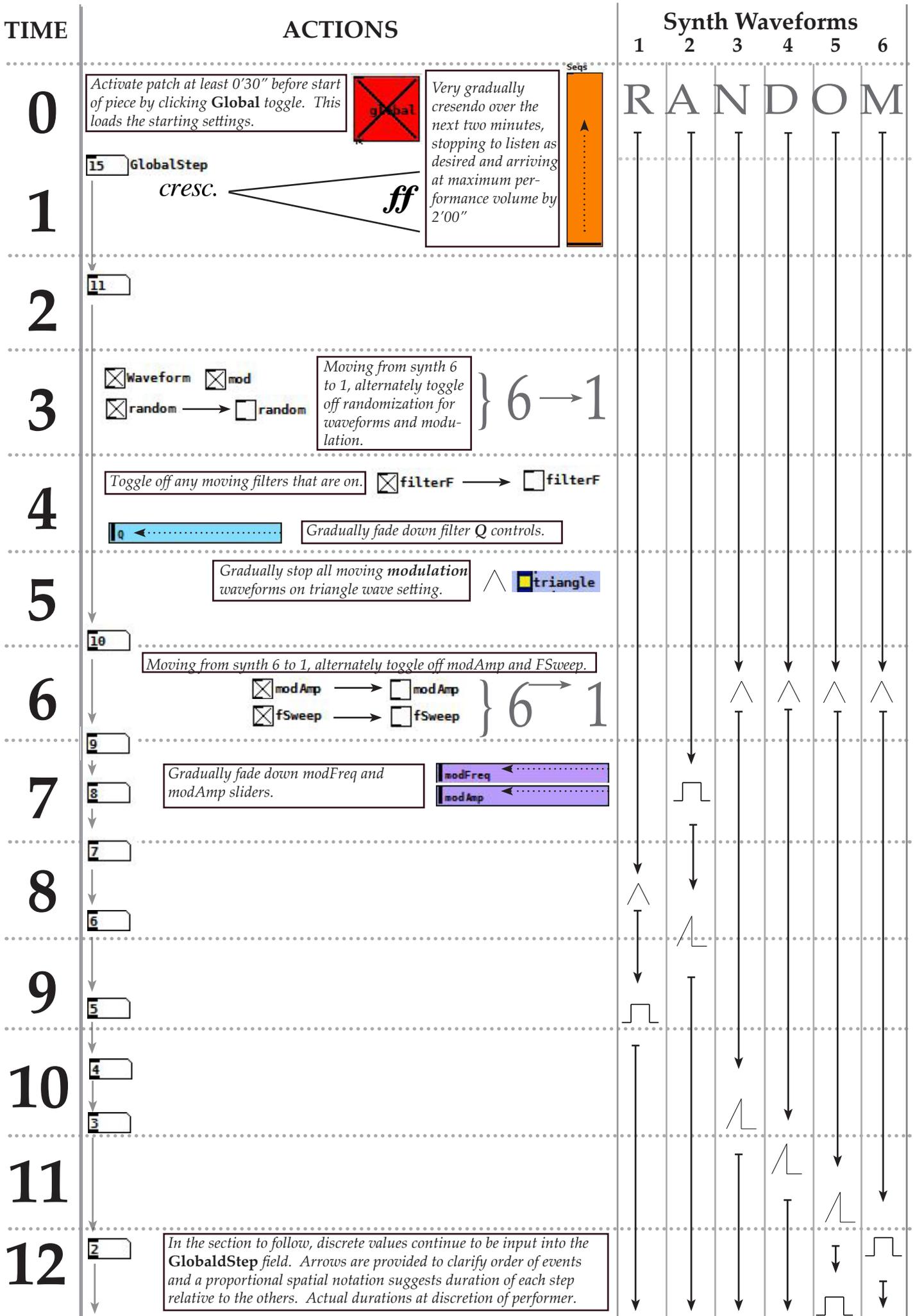
This piece requires several external libraries which can be easily installed using the built-in Deken plugin. After opening Pd, navigate to the Help menu along the upper edge of the Pd window. Click this and select "find externals" from the drop-down menu. The windows pictured opposite (without the face) appear.



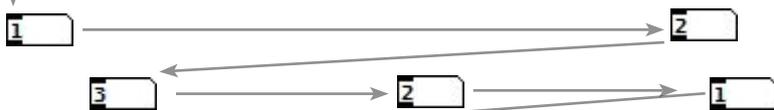
In the search bar, enter the names of the libraries in the list below one at a time and click “search.” Current versions of the libraries in the Pd repository will be listed. Select the appropriate one for your system and click on it. A message appears prompting you to install the library, either click “Yes” to install it in the default location given or “No” to specify your own location for your libraries. Note that using a location other than the default location for libraries may result difficulty in getting Pd to recognise them later. Pure Data objects that are from unrecognized libraries will appear with red outlines and where Graphic User Interface controls are present, and they will not be displayed. Incidentally, it is for this reason that the UnnaturalHabitats_PERFORMANCE patch must remain inside the folder with all of its dependencies.



The libraries that need to be installed are markex, cyclone, and zexy. The synthesizer used is a modification of Phil Stone’s polywavesynth which further relies on Frank Barknecht’s [polypoly] object, the cyclone library, and Miller Puckette’s ongoing development of Pd. These items are released under the same license as Pd itself, found here: <http://puredata.info/about/pdlicense/>. The synthesizer is driven by a sequencer of my own design. This license covers the software components of this piece and does not extend to recordings, broadcast rights, or score of this piece. I reserve all rights to my creative work and my own authorship of this piece.



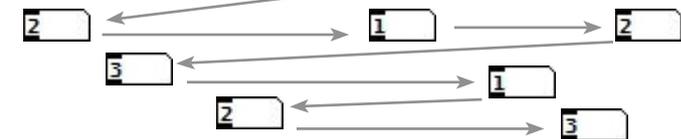
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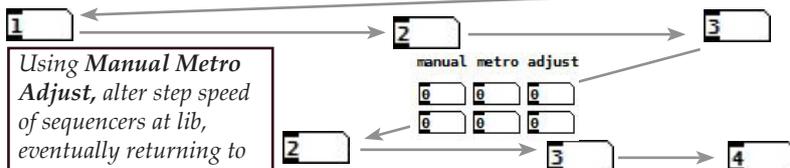
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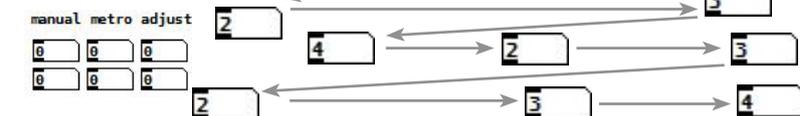


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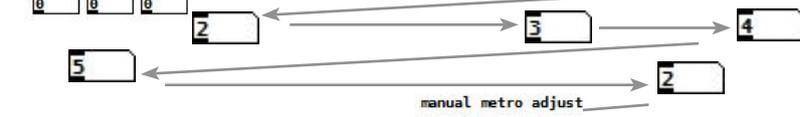


Using Manual Metro Adjust, alter step speed of sequencers at lib, eventually returning to starting values given in patch

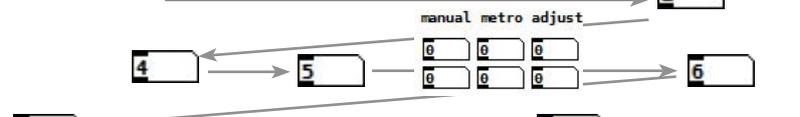
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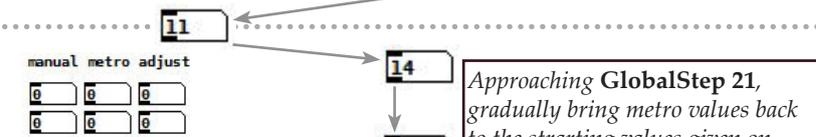
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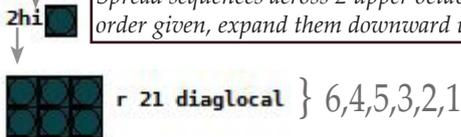
Approaching GlobalStep 21, gradually bring metro values back to the starting values given on the control surface of the patch. Just before entering 21, press the all toggles on button twice, very quickly!

22



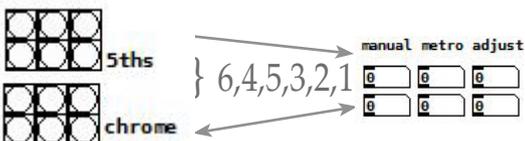
Spread sequences across 2 upper octaves, and then, gradually and in the order given, expand them downward using the r 21 buttons.

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First activate fifths, then repeatedly activate chrome controls. Between each activation alter metro of one sequencer. Do not return to starting values, but gradually expand outward to end piece at approx 26'00" with events occurring approx. every 12 seconds. Meanwhile toggle off sequencers in the order given.

24



25

