Russian-made Elysian
Cecilia 46 pedal harp

Effects of humidity on natural gut harp strings

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lever harp

Soaked section has visibly swollen

Is tension coupled
to linear density?

Twist Angle =
 $\text{Arctan} (\text{Circumference} / \text{Twist Period})$

String

String
winder

String

Winding pin

String
winder

String

Winding pin

Bridge pins

Loadcell

Plucker

Temperature &
Humidity sensor

Microphone

Fans

Heat distribution bar

Water reservoir

Shallow
tray

Twist angle = 24°

Twist angle = 24°

Red dashed lines
mark times water
was added to the
shallow tray

Twist angle = 24°

Twist angle = 24°

Is there a
threshold
effect?

Twist angle = 24°

Changes in linear density & tension appeared to cancel with almost no net effect on the frequency (when not creeping)

Twist angle = 29°

String taken from
same initial bundle
as previous one;
only difference
was the twist angle

Showed the same
behaviour – until
it broke

Twist angle = 29°

Transition points
in string tension
correspond to
start of apparent
creep

Creep rates more
than twice those
of previous string

Twist angle = 29°

Same apparent
threshold effect

Changes in linear
density & tension
again appeared to
cancel with no
net effect on the
frequency

Twist angle = 29°

Just changing the humidity level caused this string to break

String broke at this time

Twist angle = 36°

Twist angle = 36°

Initial behaviour
similar to before

Similar creep rate
to first string with
twist angle of 24°

Twist angle = 36°

Linear density
did not exceed
previous
maximum ...

... but string twice
appeared to creep
at very slow rate
following peaks in
linear density

Twist angle = 36°

Changes in linear density & tension again appeared to cancel with little net effect on the frequency

Twist angle = 36°

Is this really creep?

Tension fell 7%

Frequency fell 3%

Linear density fell 1%

So yes, it looks like
the string really was
creeping

Conclusions:

- Changing the humidity level can trigger episodes of string creep.
- The string tension and linear density really do appear to be coupled in some way.
- The degree of coupling is such that there is almost no net effect on the string frequency (outside creep episodes).
- The coupling mechanism does not appear to be related to the twist angle.
- The useful life of a gut harp string may be determined as much by its propensity to creep as by its inherent yield strength.