Research Title: A Comparative Study of Soil Properties Affecting the Population Density of *Nervilia trangensis* in Ton Noi and Ton Pliu Waterfall Areas, Kachong Sub-district, Na Yong District, Trang Province

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Abstract

This research presents a comparative analysis of the physical and chemical soil properties influencing the population density of *Nervilia trangensis* in the areas of Ton Noi Waterfall and Ton Pliu Waterfall, Kachong Sub-district, Na Yong District, Trang Province. The findings reveal distinct environmental characteristics between the two locations. Ton Noi Waterfall was characterized by high soil temperatures (29–30°C), low moisture levels (Level 1), and high light intensity (600 LM). Conversely, Ton Pliu Waterfall exhibited lower temperatures (21–27°C), higher moisture levels (Level 3), and lower light intensity (450 LM).

Regarding chemical properties, soil at Ton Noi Waterfall was slightly acidic (pH 6) with moderate potassium levels and very low phosphorus content. In contrast, soil at Ton Pliu Waterfall was neutral (pH 7) with very low levels of both potassium and phosphorus. Both sites showed very low nitrogen concentrations. These variations in moisture, light intensity, and soil nutrients serve as critical variables in determining habitat suitability, directly impacting the growth and population density of *Nervilia trangensis*. The study recorded a population of 9 plants at Ton Noi Waterfall compared to 15 plants at Ton Pliu Waterfall. This comparative data provides essential guidelines for the efficient conservation and management of watershed areas that serve as specific habitats for this terrestrial orchid species in Trang Province.

Keywords: Physicochemical properties, *Nervilia trangensis*, Population density

Introduction

Soil is a fundamental component influencing plant growth, serving as a primary source of essential nutrients, water, and providing a medium for root anchorage. Soil properties—including moisture content, pH levels, nutrient availability, and surrounding environmental conditions—play a critical role in the natural distribution of plant species. Certain plants exhibit high specificity, thriving only within precise edaphic (soil-related) and environmental parameters.

Nervilia trangensis, commonly known as "Wan Phaen Din Yen Mueang Trang," is a small terrestrial orchid first discovered in Trang Province, Thailand, and is recognized as a local medicinal herb. This species typically flourishes in high-humidity habitats near water sources. Currently, its distribution is restricted to two primary locations within Trang: Thung Khai Botanic Garden in Yan Ta Khao District and Khao Chong Botanic Garden in Na Yong District. These areas are characterized by lush, fertile tropical rainforest ecosystems. *Nervilia trangensis* exhibits a distinct phenological pattern where the foliage and inflorescence (flowers) appear at different times. The plant survives as small subterranean corms; it flowers during the dry season and transitions to vegetative growth, producing leaves similar in shape to the Ivy Gourd (*Coccinia grandis*), at the onset of the rainy season.

The researchers aim to investigate the soil properties at Ton Noi Waterfall and Ton Pliu Waterfall within the Khao Chong Botanic Garden. Given the distinct environmental characteristics of these two sites, they may significantly influence the occurrence and distribution of *Nervilia trangensis*.

Research Question

How does the population density of *Nervilia trangensis* differ between the Ton Noi Waterfall and Ton Pliu Waterfall areas?

Research Hypothesis

The physical and chemical characteristics of the soil at Ton Noi Waterfall and Ton Pliu Waterfall are significantly different, which directly impacts the population density levels of *Nervilia trangensis* in these respective areas.

2. Research Methodology

2.1 Study Site Selection

This research was conducted at the Khao Chong Botanic Garden, located in Kachong Subdistrict, Na Yong District, Trang Province. The study site is situated at the geographic coordinates of Latitude 7.55776° N and Longitude 99.77772° E.

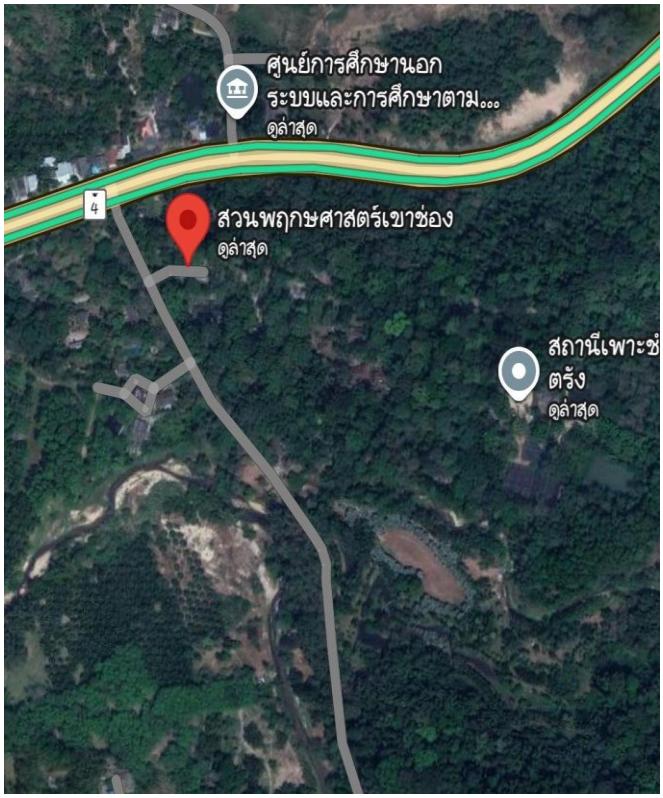

Figure 1: Location of the study sites within Khao Chong Botanic Garden, Kachong Subdistrict, Na Yong District, Trang Province (Adapted from Google Maps).

2.2 Sample Collection and Preparation

Soil samples were collected from two distinct areas within the Khao Chong Botanic Garden: the Ton Noi Waterfall area and the Ton Pliu Waterfall area. At each site, soil was collected from five randomized points to ensure representation.

The collected samples from each respective area were thoroughly mixed and combined into a plastic bag to form a composite sample representing that specific location. Subsequently, the soil samples were air-dried under direct sunlight for 2 days. Once dried, the samples were processed using a sieve to remove debris and ensure uniformity for further analysis.

Figure 2: Soil samples collected from two study sites, Ton Noi Waterfall and Ton Pliu Waterfall, were contained in separate plastic bags to serve as representative composite samples for each area (Source: Google Maps).

2.3 Analysis of Soil Physical Properties

2.3.1 Determination of Soil Moisture

Soil moisture content was measured using a Takemura analog soil moisture meter. The probe was inserted into the soil at a depth of 10 cm. A single reading was taken per point, and the data were recorded for further analysis.

2.3.2 Analysis of Light Intensity

Light intensity at the study sites was measured using a Takemura multi-function soil meter. The sensor was positioned at a depth of 10 cm (consistent with the moisture measurement) to record the light levels reaching the sampling points. Each measurement was recorded once per location for the study.

2.3.3 Measurement of Soil Temperature

Soil temperature was measured using a soil thermometer inserted into the ground at depths of 5 cm and 10 cm. The readings were observed and recorded for data analysis.

2.3.4 Analysis of Soil pH

The soil pH was measured in situ using a Takemura soil pH meter. The probe was inserted to a depth of 10 cm. A single reading was taken per point, and the results were documented.

2.4 Analysis of Soil Chemical Properties

The analysis of soil organic matter and primary nutrients (NPK) was performed using the Hanna Instruments HI3895 Soil Test Kit.

2.4.1 Determination of Soil Nitrogen (N)

A 2.5 mL volume of soil extract solution was transferred into a test tube. One packet of Nitrogen Reagent was added to the solution. The mixture was shaken thoroughly and allowed to stand for a specified period. The resulting color change was observed and compared against the standard color chart.

2.4.2 Determination of Soil Phosphorus (P)

A 2.5 mL volume of soil extract solution was transferred into a test tube. One packet of Phosphorus Reagent was added. The tube was shaken until the reagent was fully dissolved. After allowing the reaction to settle, the results were observed and recorded.

2.4.3 Determination of Soil Potassium (K)

A 0.5 mL volume of soil extract solution was diluted with 2.5 mL of distilled water in a test tube. One packet of Potassium Reagent was added, and the mixture was shaken. After a brief incubation period, the turbidity or color change was observed to determine the potassium level.

2.4.4 Analysis of Soil Solution pH

A 2.5 mL volume of soil extract solution was transferred into a test tube. One packet of pH Reagent was added and shaken. Additionally, universal indicator paper was used to verify the pH level by observing the color transition, ensuring the accuracy of the acidity-alkalinity measurement.

Research Materials and Equipment

1. **Beakers**, 100 mL (5 units)
2. **Medium-sized test tubes** (8 units)
3. **Glass stirring rods** (2 units)
4. **Digital analytical balance**
5. **Hanna Instruments HI3895 Soil Test Kits** (for pH, Nitrogen, Phosphorus, and Potassium analysis) (2 sets)
6. **Universal indicator paper**
7. **Distilled water** (1 bottle)
8. **Pasteur pipettes** (or glass droppers) (2 units)
9. **Quadrat frame**, 1 square meter (1 unit)

3. Results

3.1 Soil Physical Properties Analysis

Table 1: Physical properties of soil at Ton Noi and Ton Pliu Waterfalls, Khao Chong Botanic Garden, Trang Province.

Physical Property	Ton Noi Waterfall	Ton Pliu Waterfall
Temperature (°C)	29–30	21–27
Moisture Content (Level)	1	3
Light Intensity (Lux/LM)	600	450

3.2 Soil Chemical Properties Analysis

Table 2: Soil NPK nutrient levels and pH values at Ton Noi and Ton Pliu Waterfalls.

Chemical Property	Ton Noi Waterfall	Ton Pliu Waterfall
Nitrogen (N)	Trace	Trace
Phosphorus (P)	Trace	Low
Potassium (K)	Medium	Trace
Acidity-Alkalinity (pH)	6.0	7.0

3.3 Population Density of *Nervilia trangensis*

Table 3: Population density survey of Nervilia trangensis using 1 m^2 quadrats across five sampling points.

Sampling Point	Ton Noi Waterfall (Plants)	Ton Pliu Waterfall (Plants)
1	3	6
2	0	2
3	1	1
4	0	5
5	5	1

Research Summary

Part 1: Physical Properties of Soil at Khao Chong Botanical Garden, Ka Chong Subdistrict, Na Yong District, Trang Province

The study of soil physical properties revealed distinct characteristics between the two study sites. At Ton Noi Waterfall, the soil texture is sandy. Upon drying in sunlight for approximately two days and being finely ground, the soil granules exhibit a brown color. Field measurements recorded a soil temperature of 29-30°C, a moisture level of 1, and light intensity of 600 LM.

Conversely, at Ton Pliu Waterfall, the soil texture is also sandy. After drying in sunlight for approximately two days and being finely ground, the soil granules exhibit a grey color. Field

measurements indicated a soil temperature of 21-27°C, a moisture level of 3, and light intensity of 450 LM.

Part 2: Chemical Properties of Soil at Ton Noi and Ton Pliu Waterfalls

The analysis of chemical properties, including pH, nitrogen, phosphorus, and potassium levels, yielded the following results:

Soil pH: The soil at Ton Noi Waterfall has a pH of 6, whereas the soil at Ton Pliu Waterfall has a pH of 7.

Nutrient Analysis:

Ton Noi Waterfall: Nitrogen and phosphorus levels are classified as very low, while potassium levels are at a medium level.

Ton Pliu Waterfall: Nitrogen and potassium levels are classified as very low, while phosphorus levels are at a low level.

Part 3: Population Density Survey of *Nervilia trangensis* at Ton Noi and Ton Pliu Waterfalls

The survey results indicated a variance in plant population between the two sites based on five sampling points in each area.

Ton Noi Waterfall: A total of 9 *Nervilia trangensis* plants were found.

Ton Pliu Waterfall: A total of 15 *Nervilia trangensis* plants were found.

Note regarding translation: In your original Thai text for Part 3, "Ton Pliw" was mentioned for both 9 plants and 15 plants. Based on your "Discussion" section which states that Ton Pliu has *more* plants, I have translated the site with 9 plants as "Ton Noi" and the site with 15 plants as "Ton Pliu" to ensure logical consistency.

Discussion

The findings demonstrate distinct environmental differences between the Ton Noi and Ton Pliu Waterfall areas regarding both physical and chemical soil properties. These differences significantly influence the population density of *Nervilia trangensis*.

The Ton Pliu Waterfall area exhibits lower soil temperatures, higher moisture levels, and lower light intensity, creating a more suitable environment for the growth of terrestrial orchids compared to Ton Noi Waterfall. Soil moisture plays a critical role in water and nutrient absorption by plant roots and maintains an environment conducive to soil microorganisms. Additionally, the moderate light intensity helps reduce transpiration rates.

Regarding chemical properties, the soil at Ton Pliu Waterfall is neutral (pH 7), which is more favorable for nutrient solubility and absorption than the slightly acidic soil found at Ton Noi Waterfall. Although both areas possess very low nitrogen levels, the differences in phosphorus and potassium levels may affect root system development, nutrient accumulation, and overall plant growth.

The survey results confirm that the population of *Nervilia trangensis* is higher at Ton Pliu Waterfall than at Ton Noi Waterfall. This reflects that factors such as humidity, light, temperature, and overall soil properties clearly influence the population density of this species. These findings can serve as baseline data for formulating conservation strategies for *Nervilia trangensis*, emphasizing the importance of maintaining moist forest conditions, controlling disturbances in watershed areas, and preserving ecosystem integrity to ensure the sustainable survival of this species in its natural habitat.

Recommendations

Based on this study, it is recommended that: Soil sampling should be conducted across multiple timeframes to compare soil quality more accurately.The survey area for *Nervilia trangensis* should be expanded to minimize error and provide a more effective assessment of the population density in the Ton Noi and Ton Pliw Waterfall areas.

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