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SHORT COMMUNICATION

Detection of the Asian Subterranean Termite (*Coptotermes gestroi*) in South Korea and a Reporting-Based Management System

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Abstract

The introduction of alien species is increasing due to climate change and global trade, posing ecological and economic risks. Termites, including invasive species, can cause significant damage to wooden structures and forested ecosystems. Among these, *Coptotermes formosanus* (Formasan subterranean termite) and *Coptotermes gestroi* (Asian subterranean termite) are the most economically important. Asian subterranean termites, primarily found in tropical and subtropical regions, have recently been detected in South Korea. In April 2024, suspected Asian subterranean termite individuals were discovered in a warehouse in Seoul during the inspection of imported goods. Termites were found in packaging materials imported from Singapore, including cardboard boxes and wooden pallets. This discovery was reported to the Invasive Species Reporting Center, prompting on-site investigations by government agencies. DNA sequencing confirmed a 100% match with the Asian subterranean termite based on the COII gene. No reproductive individuals were found, and the mud tubes suggested introduction via air transport rather than local establishment. The infested materials were sealed and incinerated to prevent spread. This study underscores the importance of early detection and rapid response in managing invasive species. Public involvement and a well-coordinated reporting system play crucial roles in identifying and mitigating the risks of Asian subterranean termite establishment. Strengthening public awareness, improving quarantine measures, and enhancing early warning systems are essential for preventing future invasions. Continuous monitoring and inter-agency collaboration are critical for effective termite management in South Korea.

Key words: Invasive species, Asian subterranean termite, *Coptotermes gestroi*, Alert alien species, Hitchhiker species

1. Introduction

Recently, the intentional and unintentional introduction of alien species has been increasing due to the expansion of international trade, which has been driven by economic and industrial development, as well as the effects of climate change. In Korea, the primary entry routes for these species are ports, with most introductions occurring via containers and ships (Lim and Ahn, 2020). The introduction of alien species causes not only ecological and environmental impacts, such as biodiversity loss, but also leads to social issues, including economic losses and public health risks (IUCN, 2000; Bang et al., 2004).

Among the 26 species of invasive termites worldwide, seven are classified under the genus Coptotermes (Evans, 2011). Of these, only two species (Formasan subterranean termite and Asian subterranean termite) are considered economically significant (Chouvenc et al., 2015).

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The Asian subterranean termite belongs to the group of subterranean termites and is predominantly found in humid subtropical and tropical regions (Scheffrahn and Su, 2000; Li et al., 2013; Chouvenc et al., 2015). Invasive neighboring countries include Taiwan (Tsai and Chen, 2003) and China (Xia and He, 1986), with distribution in Taiwan confirmed as far north as latitude 24°N (Tsai and Chen, 2003; Yeap et al., 2014).

Species of the subterranean termite group are generally photophobic, forming mud tubes with excrement, soil, and clay to minimize moisture loss and evaporation as they travel. They display a natural habit of sealing cracks in wood and similar substrates with composite materials ro reduce water loss (Haverty, 1976; CHA, 2012; Son et al., 2014; Kim and Kim, 2024). Swarming flights of alates from Asian subterranean termite are known to be influenced by environmental factors (Nutting, 1969). According to Neoh and Lee(2009), swarming primarily occur at temperatures of 27-28°C, relative humidity of 83-84%, and atmospheric pressure of 1009-1010 hPa. In the case of subterranean termites, workers and soldiers tend to be photophobic, but alates are typically drawn to light (Scheffrahn and Su, 2000) which causes them to be drawn to lights near ports, leading to their introduction via ships. In the case of Taiwan, the Asian subterranean termite has been found not only un urban areas but also in natural environments unaffected by human activity, suggesting that it can survive independently of human-modified environments.

Termites of the genus Coptotermes are among the primary species that attack living trees (Tho, 1974; Apolinario and Martius, 2004; Jasmi and Ahmad, 2011). Specifically, Asian subterranean termite has been reported to damage Pinus elliottii (slash pine), causing tree mortality, and also affects species in the family Fagaceae, such as Quercus virginiana (live oak) (Chouvenc and Foley, 2018). Trees damaged by Asian subterranean termitei feeding have been reported to collapse during hurricane Wilma in 2005 and hurricane Irma in 2017 (Chouvenc and Foley, 2018).

Four termite species previously unreported in Korea were identified through reports submitted to the Invasive Species Reporting Center, operated by the Ministry of Environment and the National Institute of Ecology (Lee et al., 2024a, 2024b; An et al., 2024). In 2020, during quarantine inspections, one case involving Asian subterranean termite was confirmed (APQA, 2021; Kim and Kim, 2024). Subsequently, in 2023, this species was discovered in a warehouse and reported to the Invasive Species Reporting Center, where the report was reviewed.

Currently, the influx of invasive species is on the rise, necessitating swift action. The Invasive Species Reporting Center relies on reports from both private and public sectors to swiftly identify and address these introductions. Reports of suspected foreign termites in Seoul in 2024 highlight the importance of public engagement in early detection and management. This also indicates that collaboration between relevant organizations and the public can effectively prevent the establishment of invasive species.

This study aims to provide a brief overview of the current status of invasive termite management and to discuss the importance of early detection and rapid response during the early stages of introduction, based on cases reported to the Invasive Species Reporting Center operated by the Ministry of Environment and the National Institute of Ecology.

Fig. 1. Photographs submitted to the Invasive Species Reporting Center.

2. Materials and Methods

2.1. Detection route of termites

On April 24, 2024, during the inspection of imported goods at a wholesaler's warehouse in Seoul, termites suspected to be invasive species were found in packaging paper boxes and wooden pallets, and immediately reported to the Invasive Species Reporting Center (Fig. 1). The goods were imported into Korea from Singapore through Incheon Airport on April 23, 2024, and delivered to the warehouse by truck on April 24. On the day of the report, a joint on-site investigation was conducted by Animal and Plant Quarantine Agency (APQA), National Institute of Forest Science (NIFoS), National Institute of Ecology (NIE), and Geumcheon-gu District Office.

2.2. DNA sequence analysis

For DNA sequence analysis, termite samples preserved in 80% ethanol were utilized. DNA extraction, amplification, and sequencing were conducted by Macrogen, Int., (Seoul, Korea). Primers targeting the mitochondrial COI and COII genes were employed for DNA amplification (Table 1). The annealing temperatures were set at 47°C for COI and 46°C for COII (Fig. 2).

3. Results and Discussion

The DNA sequencing analysis successfully amplified the COII region, and the sequence analysis using BioEdit and an NCBI BLAST search confirmed a 100% match with *C. gestroi*, the Asian subterranean termite. However, attempts to amplify the COI region were unsuccessful. In xylophagous insects, the digestive tract contains high concentrations of plant phenolic compounds (Strauss and Zangerl, 2002; Chown and Nicolson, 2004), which can act as potent oxidizing agents. These compounds covalently bind with the extracted DNA, potentially causing damage or inhibiting the activity of restriction endonucleases and Taq polymerase, thereby interfering with the DNA extraction and amplification processes (Lodhi et al., 1994; Friar et al., 2005; Padmalatha and Prasad, 2006; Li et al., 2007; Arif et al., 2010).

On April 24, 2024, an employee inspecting imported goods at a wholesale warehouse in Seoul discovered Asian subterranean termite and promptly reported it to the Invasive Species Reporting Center (Fig. 1). The investigation confirmed that the packaging materials containing the termites had been imported from Singapore to Incheon on April 23, 2024, and

Table 1. Oligonucleotide primers used for the amplification and sequencing of termite Cytochrome Oxidase I and II (Source: Thompson et al., 2000)

Target Gene	name	Sequence	Product size
CO I	LCO1490	GGTCAACAAATCATAAAGATATTGG	650bp
	HCO2198	TAAACTTCAGGGTGACCAAAAAATCA	
COII	C2-J-3096	AGAGCATCACCAATCATAGAACA	660bp
	TK-N-3807	GTTTAAGAGACCATTACTTA	

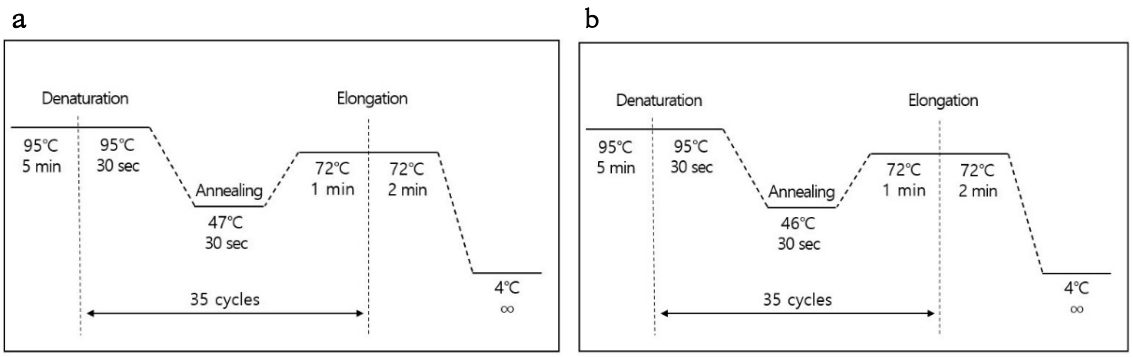

Fig. 2. PCR temperature condition (a) CO I (b) COII.

transported to the warehouse the following day.

The discovery site was a fully enclosed office space repurposed as a warehouse with a tiled floor. Along one wall, boxes containing imported goods showed no signs of termite infestation. However, over 1,000 individuals (including workers and soldiers) were found in the affected boxes and pallets, but no reproductive individuals were observed.

Mud tubes, indicative of termite activity, were present on both the boxes and pallets, prompting an internal inspection (Fig. 3). The boxes exhibited signs of damage and habitation, whereas sectional examination of the pallets revealed no significant structural damage. Following the on-site investigation, the affected materials were treated with insecticide, sealed in plastic, and incinerated to prevent further spread. Additional measures were implemented to ensure immediate capture and reporting of any newly discovered individuals.

Termite dispersal primarily occurs through worker foraging activities or the swarming flights of alates during mating (Scheffrahn and Su, 2000; Kim and Kim, 2024). In this case, the discovery site lacked soil necessary for mud tube formation, and no alates were observed. Therefore, the likelihood of external dispersal was considered low.

A comparison of the mud tubes observed at the site revealed that those on the pallets were larger, consistent with the tendency for mud tubes to increase in size as they near the nest (FRI, 2003; Fig. 3). It is presumed that termites initially infested the pallets during loading in their country of origin before spreading to the cardboard boxes, leading to their inadvertent introduction into South Korea.

According to the Act on the Conservation and Use of Biological Diversity (Biodiversity Act), alien species that may pose a threat to ecosystems are legally designated and managed.

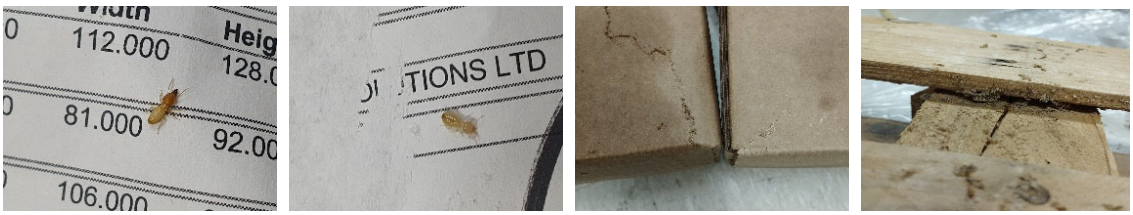

Fig. 3. Termites (Soldier, Worker) were confirmed on-site, along with mud tubes on cardboard boxes and wooden pallets.

Table 2. List of invasive termites designated as alert alien species (as of October 31, 2024)

Designated year	Family	Species	Common Names
2023	Kalotermitidae	*Cryptotermes brevi*	West Indian drywood termite
	Rhinotermitidae	*Reticulitermes lucifugu*	Italian subterranean termite
2024	Kalotermitidae	*Incisitermes snyderi*	Light southeastern drywood termite
	Rhinotermitidae	*Coptotermes formosanus*	Formasan subterranean termite
		Coptotermes gestroi	Asian subterranean termite
		Crytotermes cynocephalus	Indo-malaysian drywood termite
		Reticulitermes flaviceps	-
	Termitidae	*Odontotermes formosanus*	Black-winged subterranean termite

The term "alert alien species" refers to species that have not yet been introduced into South Korea but may pose a threat to the ecosystem if introduced. As of October 31, 2024, a total of 312 plant species, 144 fish species, 95 insect species, and 60 mammal species have been designated as alert alien species (Cho et al., 2025). If an alert alien species is imported or detected in the ecosystem, a risk assessment is conducted to classify it into one of three risk levels (Grades 1–3). Based on the assessment results, the species is then designated and managed as an ecosystem-disturbing species, a species of concern for ecosystem risk, or an unregulated species (Cho et al., 2025).

Currently, eight termite species have been designated as alert alien species, including Asian subterranean termite, which was newly listed in October 2024 (Table 2). If a termite species designated as an alert alien species is detected in the ecosystem, necessary control measures can be requested from the relevant central administrative agency or local government under the Biodiversity Conservation and Utilization Act.

This case underscores the critical importance of early detection and rapid response in preventing the establishment and spread of invasive species. Prompt reporting through the Invasive Species Reporting Center, combined with effective collaboration among relevant organizations, played a pivotal role in mitigating the risk posed by Asian subterranean termite. Notably, public engagement and proactive participation were instrumental in the early identification and management of the invasive termite, highlighting the value of citizen involvement in biosecurity efforts.

Strengthening public awareness, improving quarantine inspections, and enhancing early warning systems are essential to prevent future introductions of invasive species. In addition to legal frameworks, continuous monitoring and cooperation among government agencies,

research institutions, and the public will be crucial in maintaining an effective invasive species management system in South Korea.

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