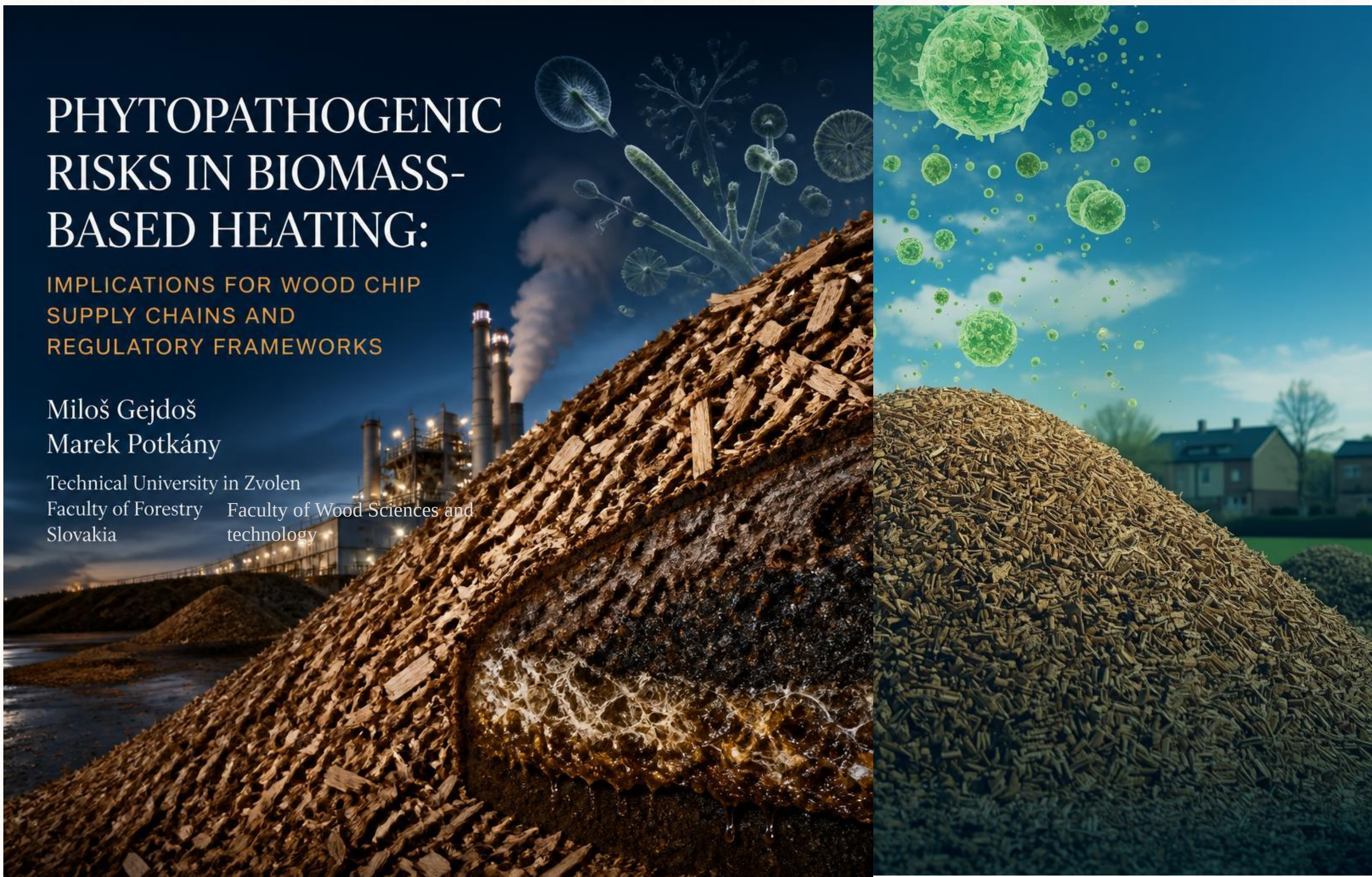


PHYTOPATHOGENIC RISKS IN BIOMASS- BASED HEATING:

IMPLICATIONS FOR WOOD CHIP
SUPPLY CHAINS AND
REGULATORY FRAMEWORKS

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Why should we care?



Biomass **has become** key energy source

- District heating plants widely use wood chips as renewable fuel
- Wood chips are commonly stored for 2-3 months in large piles

Hidden biological processes

- Temperature and moisture increase during storage
- **Favourable conditions for** fungal growth and spore production

Potential health risks

- Wood dust and spores may cause allergies and respiratory diseases
- Risks affect both workers and nearby residents

Regulatory gap

- Biological agents are recognized as hazardous
- **Specific exposure limits and regulatory requirements are still largely missing** in Slovak legislation

Research objective

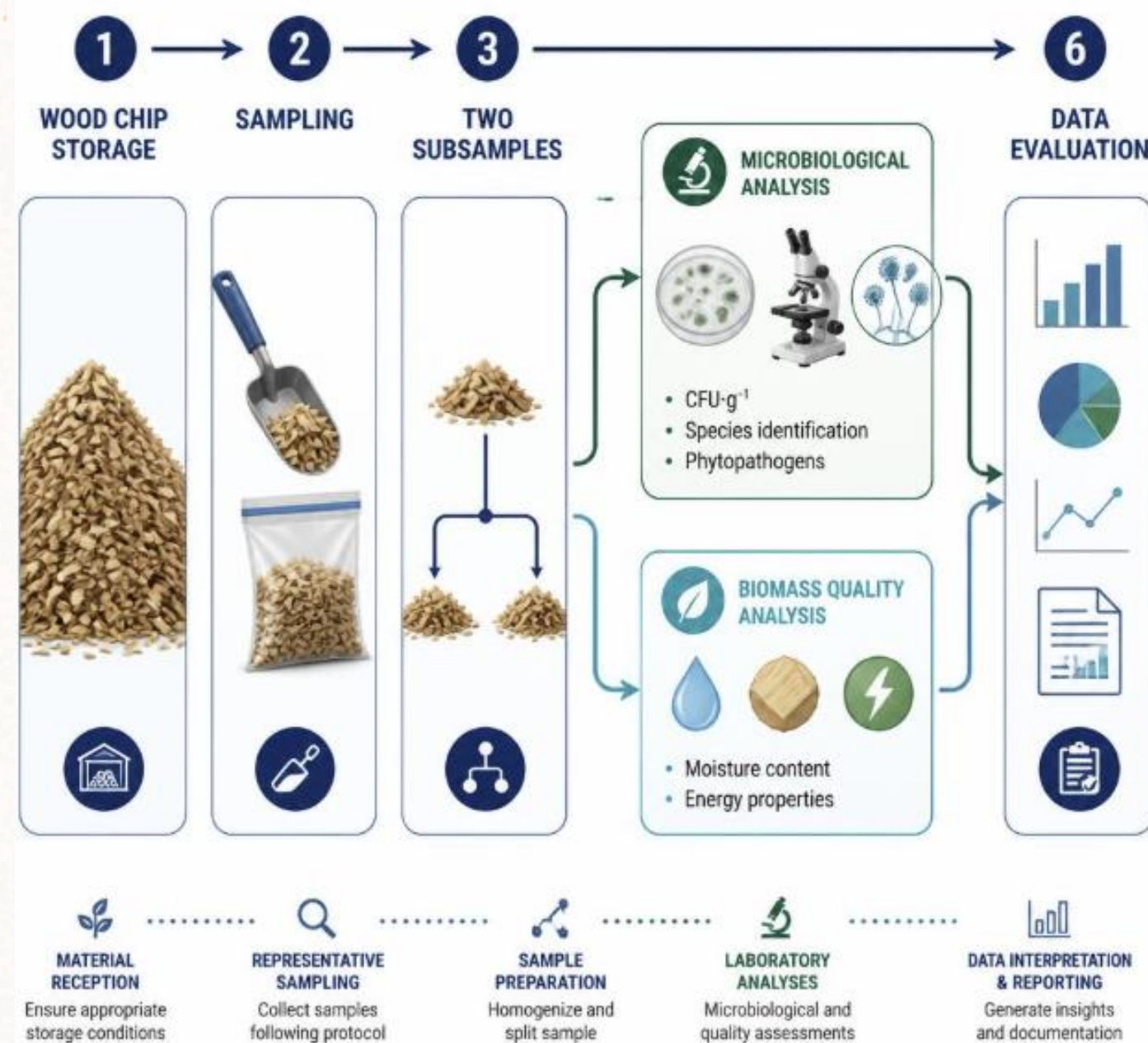
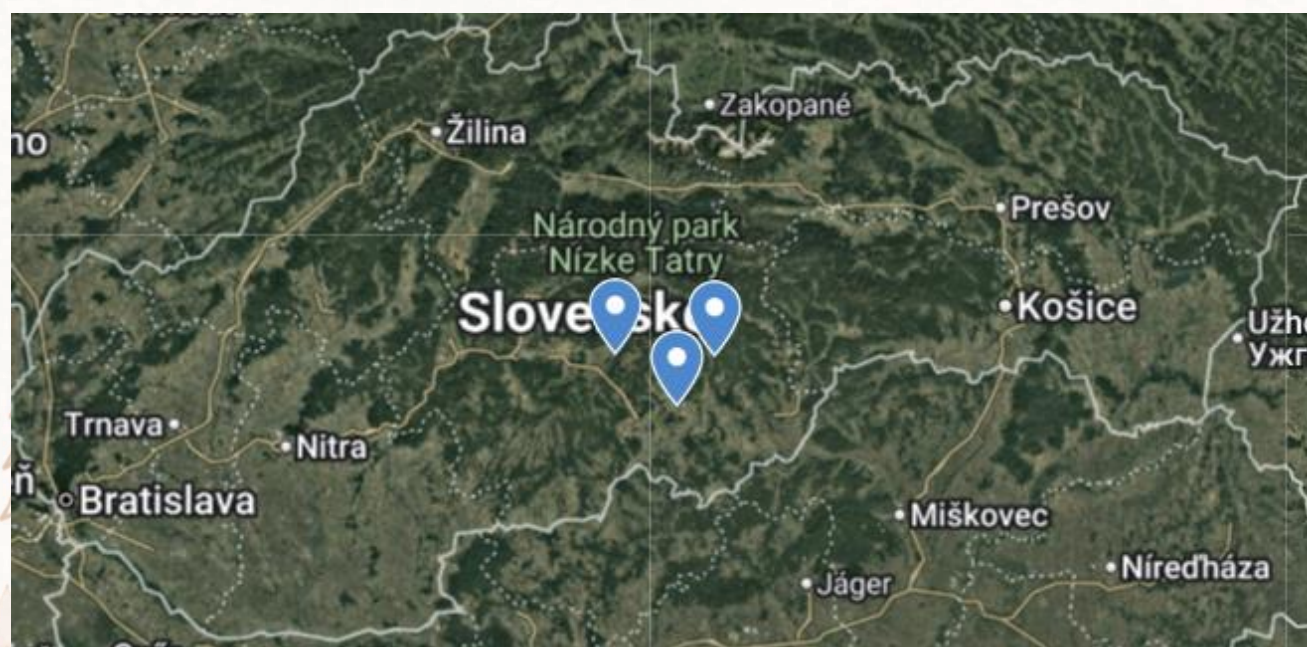
Identify **the main** health risks associated with wood chip storage and **to** propose **possible** mitigation measures



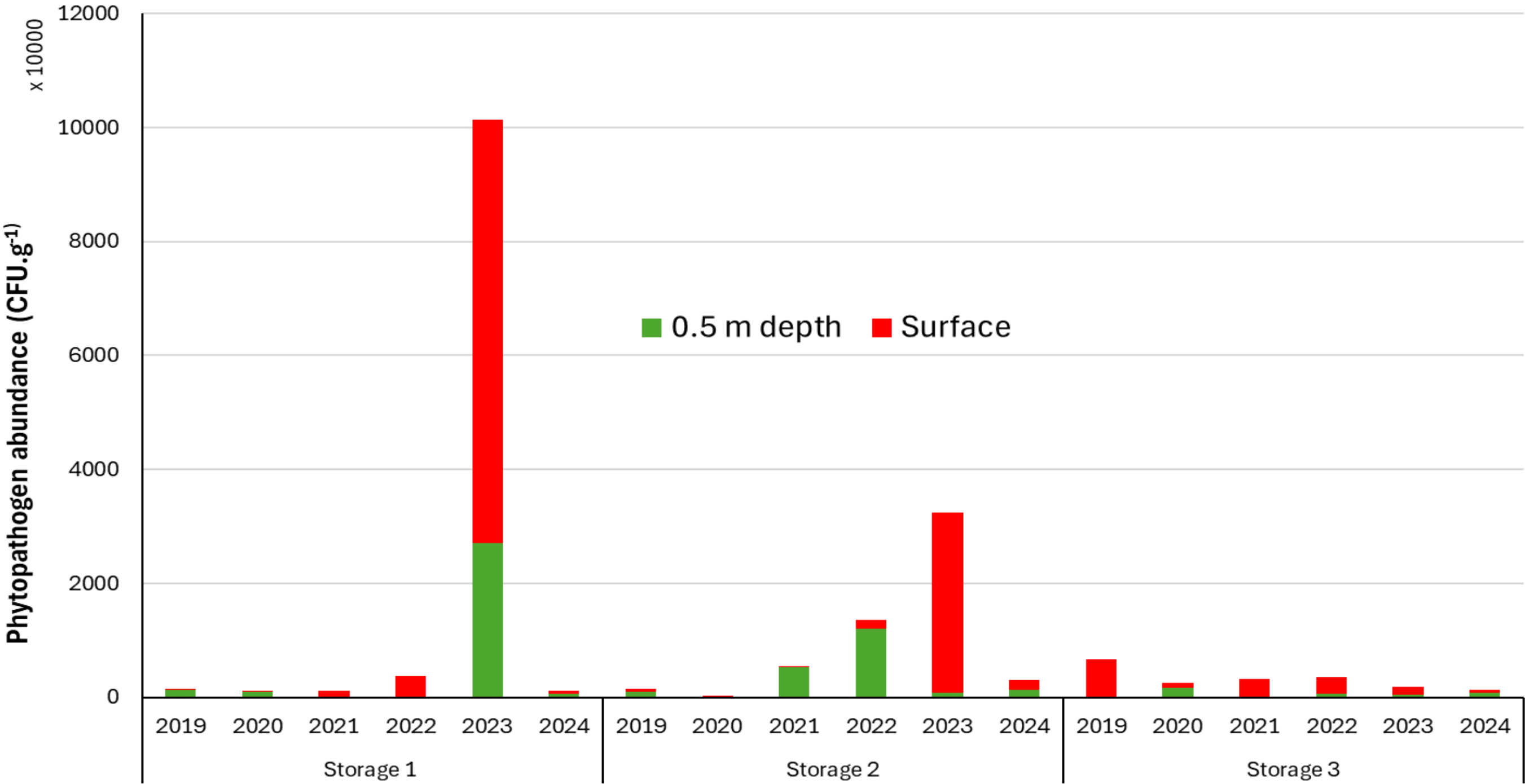
Study Sites & Biomass Sampling

Three district heating plants located within a 45 km radius were monitored annually between 2019 and 2024.

- 2019-2024
- 5 samples / plant / year (Surface layer - 3 samples 0.5 m depth - 2 samples)
- 15 samples / year
- 90 samples total measures

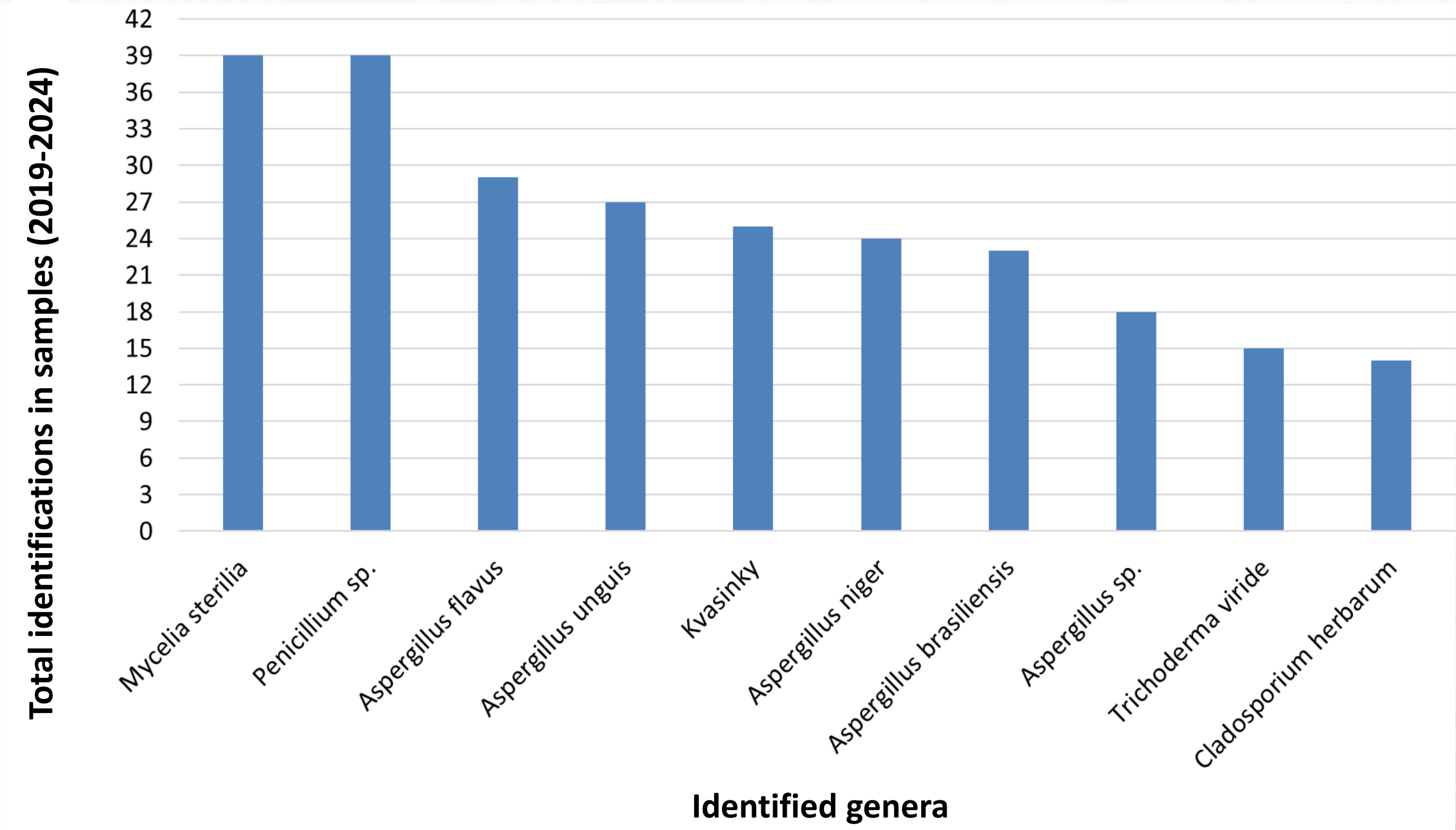


Total microbial load

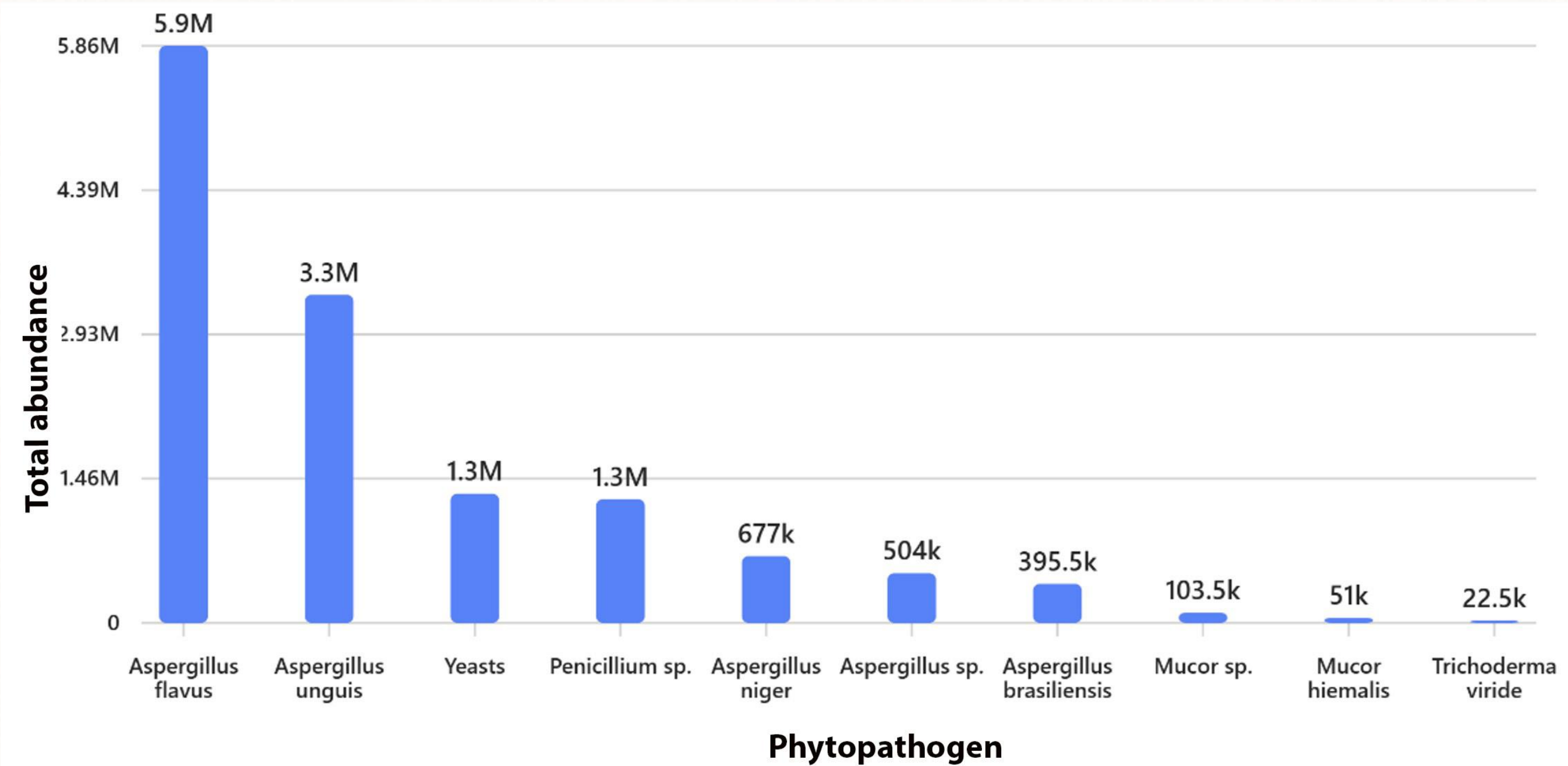


Highest contamination was observed in Storage 1 and Storage 2, with markedly elevated values in 2023.

Frequency of occurrence



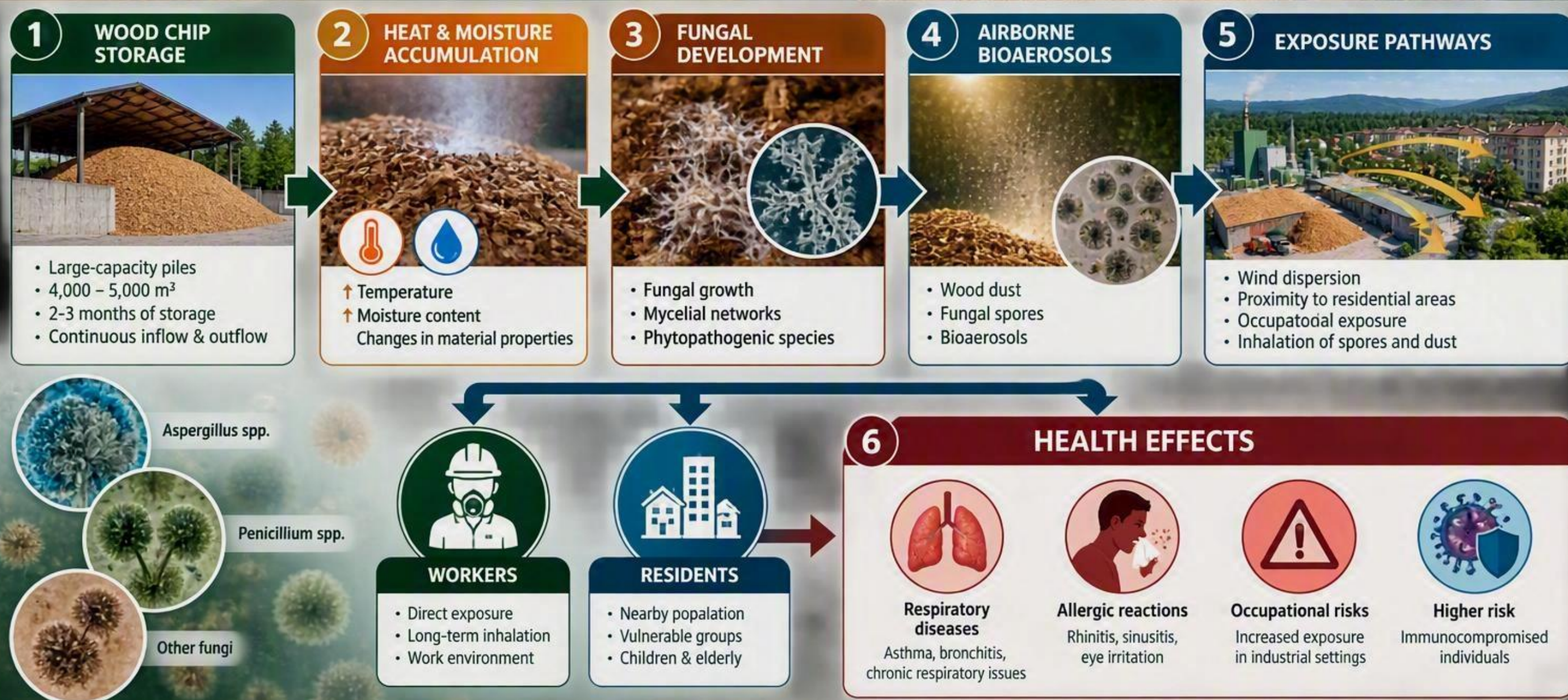
Total abundance



Aspergillus flavus and *Aspergillus unguis* accounted for more than 60 % of the total identified phytopathogenic abundance.

HEALTH RISK ASSESSMENT

From biomass storage to health impacts



KEY FINDING

Wood chip storage creates favourable conditions for fungal growth and bioaerosol production, potentially affecting both occupationally exposed workers and residents living near biomass storage facilities.



Legislative Gaps in Biomass Storage Safety

✓ Existing Regulation

- ☐ Phytopathogens classified as Risk Group 2
- ✓ Human health hazard recognized
- ✓ Most species classified as allergens
- ✓ Basic occupational protection required

✗ Missing Regulation

-  No exposure limits for bioaerosols
-  No minimum distance from residential areas
-  No routine monitoring requirements
-  No limits for airborne fungal spores
-  Lack of specific guidance for biomass storage sites

Biological hazards associated with biomass storage are recognized by legislation, yet specific exposure limits and protection measures remain largely undefined.

SCIENTIFIC EVIDENCE OF HEALTH RISKS ASSOCIATED WITH WOOD CHIP STORAGE

EVIDENCE & SOURCE

SCIENTIFIC EVIDENCE



- Long-term monitoring
- Microbiological analyses
- Standards:
STN ISO 21527-2
STN ISO 7218
STN 56 0100

WOOD CHIP STORAGE



- Large piles (4,000 – 5,000 m³)
- 2–3 months of storage
- Located near residential areas

TEMPERATURE & MOISTURE ACCUMULATION



- Temperature increase
- Moisture accumulation
- Changes in material properties

FUNGAL GROWTH



- *Penicillium* spp.
- *Aspergillus* spp.
- Yeasts
- *Mycelia sterilia*

BIOAEROSOL PRODUCTION



- Fungal spores
- Wood dust
- Airborne particles

EXPOSURE & IMPACT

EXPOSURE PATHWAYS



Workers



Nearby residents

POTENTIAL HEALTH RISKS

- Allergic reactions
- Respiratory diseases
- Occupational exposure
- Higher risk for immunocompromised individuals

MOST FREQUENTLY DETECTED (2019–2024)



Aspergillus flavus



Aspergillus unguis



Penicillium spp.



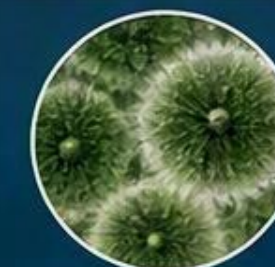
Aspergillus brasiliensis



Yeasts



Mucor spp.



Trichoderma viride



KEY MESSAGE

Scientific evidence confirms that large-scale wood chip storage can promote fungal growth and bioaerosol production, creating **potential health risks** for workers and nearby residents.

Proposed Mitigation Measures

Monitoring

- Regular microbiological monitoring
- Airborne spore monitoring
- Exposure assessment

Technical measures

- Pile size optimization
- Moisture control
- Storage rotation
- Dust reduction

Worker protection

- FFP2/FFP3 respirators
- Protective clothing
- Staff training
- Exposure minimization

Legislative Measures

- Biological exposure limits
- Mandatory monitoring
- Minimum buffer distance from residential areas
- Risk management plans

KEY RECOMMENDATION

An effective risk management strategy should combine monitoring, technical measures, worker protection and legislative improvements.

Conclusions

- ✓ Wood chip storage creates favorable conditions for fungal development and bioaerosol production.
- ✓ Aspergillus and Penicillium species were among the most frequently detected and most abundant fungal taxa.
- ✓ Potential exposure may affect both workers handling biomass and residents living near storage facilities.
- ✓ Current legislation lacks specific biological exposure limits and requirements for routine monitoring.

Take-home Message

- Effective risk management should combine microbiological monitoring, technical measures, worker protection, and legislative improvements.

THANKS FOR PAYING ATTENTION!



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