**ABSTRACT**

The permanently ice covered lakes of Antarctica's Dry Valleys region harbor a diverse group of microbes that live in unique liquid water habitats. In particular, the lake ice hosts microbial communities that form functional ecosystems. My research focuses on the functional role of fungi in the permanent ice covers of lakes in the McMurdo Dry Valleys. Laboratory cultures obtained from ice cores taken from two lakes were tested for growth characteristics under various temperature and nutrient regimes. Partial ITS- DNA sequencing was used to screen for functional genes and to identify novel fungal types unique to this region of Antarctica. Our results show that axenic cultures were successfully obtained from the permanent ice cover of the lake ice. Temperature experiments revealed that these organisms were psychrotolerant, but grew most rapidly at 20°C. In addition, the isolated organisms possess antifungal activity that has not been previously reported from fungi isolated from Antarctic lake ice. Results from the study will be the first to address the structure and function of fungi in these sub-zero habitats and the potential for elucidating life to exist in icy worlds beyond Earth.

**OBJECTIVES AND HYPOTHESES**

**Overarching Objective:**
To study the structure, function, and distribution of fungi in the lake ice ecosystem of the McMurdo (MCM) Dry Valley lakes.

**Hypotheses:**
1. Fungi are present in the lake ice and are viable as spores and mycelium.
2. Fungi in the lake ice are Psychrophilic.
3. Fungi in the lake produce bioactive volatile compounds.

**STUDY SITE**

Taylor Valley, Antarctica

---

**METHODS**

**Field Sampling:**
Samples were collected during the 2012-2013 field season from several lakes in Taylor Valley (Figure 1).

**Decontamination Protocol:**
Ice cores were decontaminated using the protocol of Christner et al., 2005 in a Class 1000 Cold Clean lab (Figure 2).

**Isolation and Culturing:**
Fungal mats were isolated and cultivated on Potato Dextrose Agar (PDA) medium.

**Phylogenetic identification:**
1. DNA extraction using DNeasy Plant Mini Kit (Qagen).
2. Phylogenetic analysis was carried out by the acquisition of the ITS-5.8 S ribosomal gene sequence.
3. The ITS regions of the fungus were amplified with the universal primer 1 and 2 using PCR (White et al. 1990).
4. Sequencing was performed by Functional Biosciences (Madison, WI).
5. Sequences were organized and queried against the NCBI database using an in house program (SeqTrace).

**Growth Rates:**
The isolated cultures grown on PDA plates were tested for growth characteristics at several different temperatures.

**Antimicrobial Activity of Fungi:**

**Dual Culture assay:**
An agar block of a 15-day old culture of fungus was placed in the center of PDA plate and the pathogen was inoculated at 2 cm juxtaposed to the pathogen and tested for bioactivity (Figure 3).

**Gas test:**
An agar strip 2.5 wide was completely removed from the mid-potion of a Petri plate of PDA. Then, the test organism was inoculated and grown on one side while the pathogen was placed on the agar half moon strip on the opposite side of the plate (Figure 4).

**RESULTS**

- Figure 5 demonstrates isolation and characterization of fungi from the lake ice was achieved.
- Based on the morphology and DNA analysis it was confirmed that these isolates were axenic.

**REFERENCES**


---

**CONCLUSIONS**

1. Axenic cultures were successfully obtained and identified from the permanent lake-ice cover:
   - *Tetracladium* sp. from Lake Chad
   - *Mucorales* sp. from East Lake Bonney
   - Unknown from East Lake Bonney

2. Temperature experiments revealed that the isolated organisms were psychrotolerant. Growth rate was greatest at 20°C.

3. The isolated organism *Tetracladium* sp. possess antifungal activity against known plant pathogens that has not been previously reported from fungi isolated from Antarctic lake ice.

**SIGNIFICANCE**

Isolating and characterizing fungi in the icy ecosystem of the dry valleys provides a better understanding of the component members of the ecosystem that have not been studied previously. These fungi from the polar region are capable of inhibiting the growth of detrimental pathogens. This could have several promising applications in the field of medicine and agriculture.

---

**ACKNOWLEDGEMENTS**

The authors would like to acknowledge the Undergraduate Scholars Program, NSF’s Division of Polar Programs, NSF-LTER Program, PB Helicopters Inc. for air support in the Dry Valleys, as well as all of the members of the 2012-2013 field team.