

## DETECTION AND DOCUMENTATION OF FOREST DISEASE IN JIGME DORJI NATIONAL PARK IN BHUTAN FOR FOREST CONSERVATION

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### Background

Forests play a fundamental role in combating rural poverty, ensuring food security and providing decent livelihoods (FAO, 2010). They provide critical refuge for terrestrial biodiversity and a central component of the earth's biogeochemical systems with potential to mitigate climate change by serving as net carbon sinks (Shvidenko *et al.*, 2005; IPCC, 2007). Bhutan's rich forest are in unique position as forest conservation are primary based on Traditional Social Restriction System, Buddhist principles, Gross National Happiness (GNH) vision and less than 9% was under scientific management with huge gaps in Forest Pathology. Diseases outbreak since 1980s has shown potential threat to forest management, conservation and biodiversity of Bhutan (Donaubauer 1986, 1987, 1993; Tshering and Chhetri, 2000, Coetzee *et al.*, 2005; Dorji 2007). However, Bhutan is unprepared in the forest pathology discipline and finding the references about forest diseases is challenging due to the lack of forest pathologists, research and documentation. This project came in right time to rescue the forest against diseases in this critical time of climate change.

### Problem statement

- Bhutan still lack forest diseases inventory
- Forest protection activities are concentrated only to wildfire and anthropological activities.
- Forest diseases research is in infancy stage.
- There is a huge lacuna of knowledge base in forest pathology in Bhutan.

### Aim and objectives

- To undertake a comprehensive inventory of diseases in JDNP.
- To detect and document the diversity of forest diseases and provide disease incidence and severity index.
- To create base line information and to fill the research gap in forest pathology discipline in Bhutan.
- Education and awareness

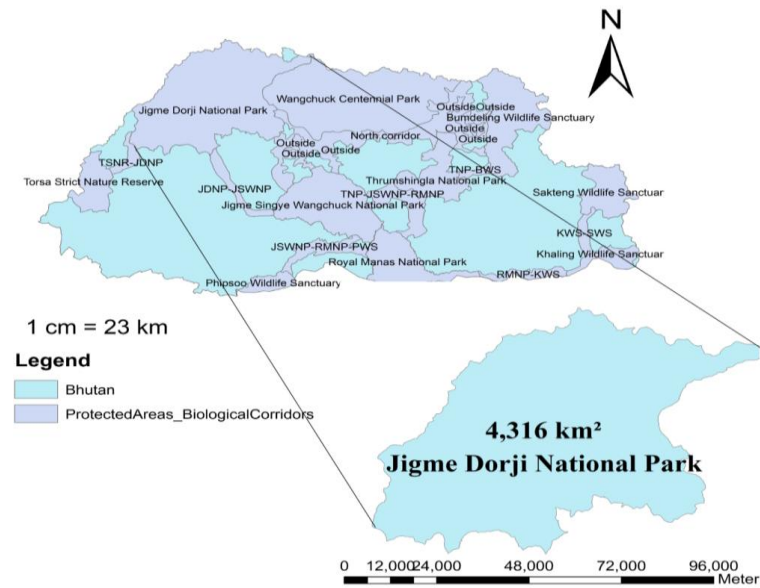


Fig 1 Study area (Jigme Dorji National Park, Bhutan)

### Methodology

#### Reconnaissance survey

#### Detection programmes

- Remotes sensing and GIS
- Area sampling
- Field surveillance

#### Purposive sampling

- Questionnaire survey

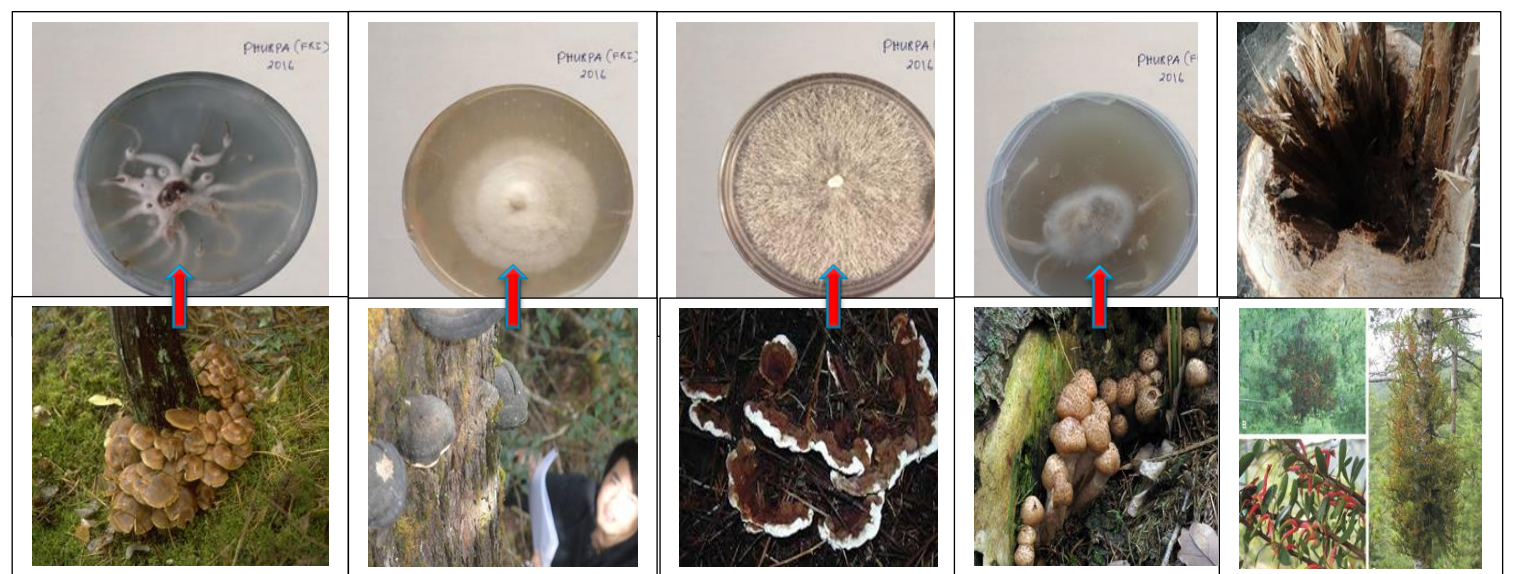


Fig 2 Pathogens and its pure culture

Table 1 Summary of forest pathogens

Si No	Pathogens	Numbers
1	Fungi	15
2	Mistletoes	3
3	Insect pests	2

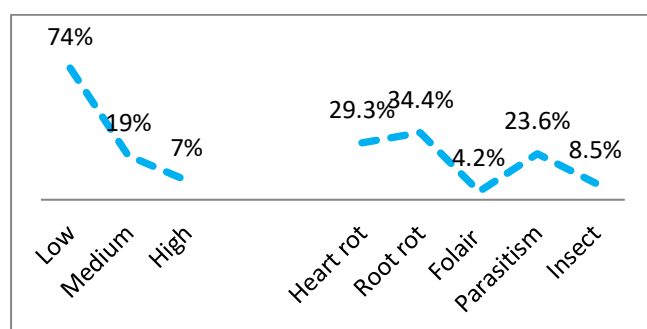


Fig 3 Disease severity and type (percentage)

This study confirmed a total of 20 forest pathogens, 15 fungi belonging to 11 families, 3 mistletoes belonging to 2 families and 2 insect pests belonging to 2 families. Shinnon Wiener and Simpson diversity index (0.0001-2.4999, 0.000-0.8000) concluded that hosts have low to medium pathogens diversity with average of host to pathogens ratio 1:4. However, each host's pathogens are evenly distributed according to Pielou evenness index (0.7500-1.0000). Mean disease incidence percentage was 28.8 (SD=13.21) and disease severity index was 0.415 (SD=0.165) and shown that disease incidence and severity index have significant relationship ( $r=0.9$ ,  $p=0.05$ ). Further, disease incidence was directly proportional to increase in altitude ( $r=0.88$ ) and GBH ( $r=0.88$ , multiple  $R=0.94$ ,  $p<0.05$ ). Study also showed significant variation of pathogens abundance in JDNP ranges ( $\chi^2=58$ ,  $df=4$ ,  $p=0.05$ ) and confirmed 65% of diseases in pure forest and 35% in mixed forest ( $\chi^2=0.14$ ,  $p=0.05$ ,  $df=1$ ). Most of fungal diseases were seen in northern aspect however, mistletoes and beetles were seen in southern aspect. Study concluded that there were different dominant predisposing factors for each hosts and only 19.16% of pathogens were sharing same host.

### Conclusion

In Bhutan, forest resource is vast and will provide wood and ecological functions for a multitude of purposes indefinitely, if managed wisely and used sustainably. However, human need for lumber and other wood products often conflicts with the natural loss of these products through diseases. Disease outbreaks also affect other resources valued by society such as aesthetics, recreation, water and wildlife. If conservation and productivity are to be sustained, forests have to be protected against fire, indiscriminate cutting, encroachment and equally important against insect pests and diseases.

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