



# Tree Population Dynamics of Large-scale Mature Urban Forest in Kyoto city, Japan

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The 3rd International Workshop on ILTER Ecological Information  
Management in the East Asia-Pacific Region  
- Promotion of ILTER Network Activities on Ecological  
Information Management in the East Asia-Pacific Region -

16-21 October 2007  
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1. Introduction  
(Back Grounds of this research)
2. Highlight Data  
(Census Methods, Results)
3. Summary & Future plan



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# Important roles of Urban Forests

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- Improvement of urban environment
- Recreation space for urban residents
- Wildlife Habitat

And more....

But most urban forests has been disappeared  
And remnants has been fragmented each other



# Preserved Forest in Urban Area of Japan

In Japanese traditional religion,  
Natural deities has been greatly worshiped



Trees in shrines have been protected



Intact woods in urban area remains as shrine forests

Shimogamo-Jinja is the oldest shrine in Kyoto city  
It is surrounded by vast forest, Tadasu-No-Mori.



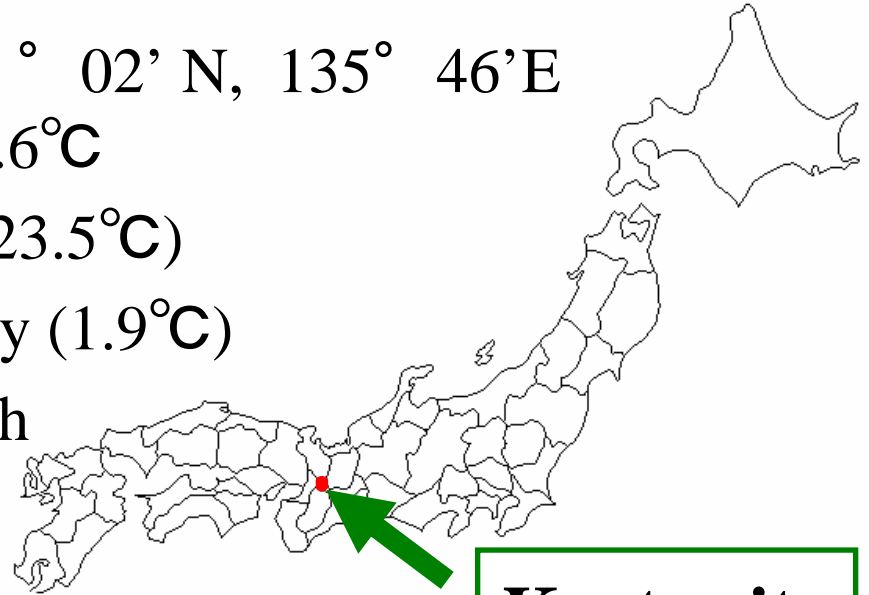
# Tadasu-No-Mori Forest





## Location of Study site - Kyoto city -

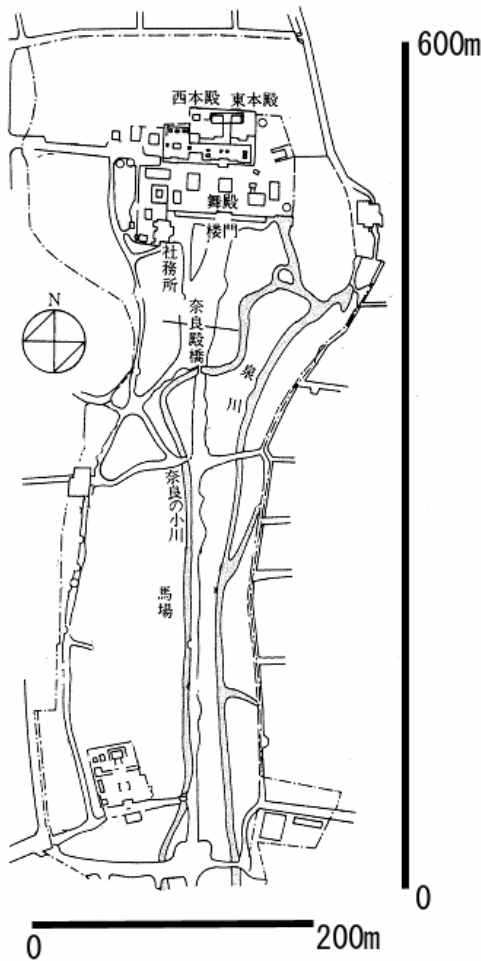
- Located in western Japan 35 ° 02' N, 135 ° 46' E
- Mean annual temperature: 15.6°C
- Highest temperature in July (23.5°C)
- Lowest temperature in January (1.9°C)
- Warm Index : 132.6 °C·month



**Kyoto city**

- Located in the warm temperate zone
- Climax Forest Phase: Evergreen Broad-Leaved Forests
- Mean annual precipitation : 1545.4 mm

# Tadasu-No-Mori Forest



- Whole Area: 12.4 ha  
(woods area only : 9.08 ha)
- Registered as the World Heritage of UNESCO in 1994
- Dominant Species:
  - Ulmacea* deciduous broadleaved
    - *Aphananthe aspera*
    - *Celtis sinensis*
    - *Zelkova serrata*

# Why had Tadasu-No-Mori been *Ulmaceae*, deciduous broad-leaved forest ?

Tadasu-No-Mori Forest



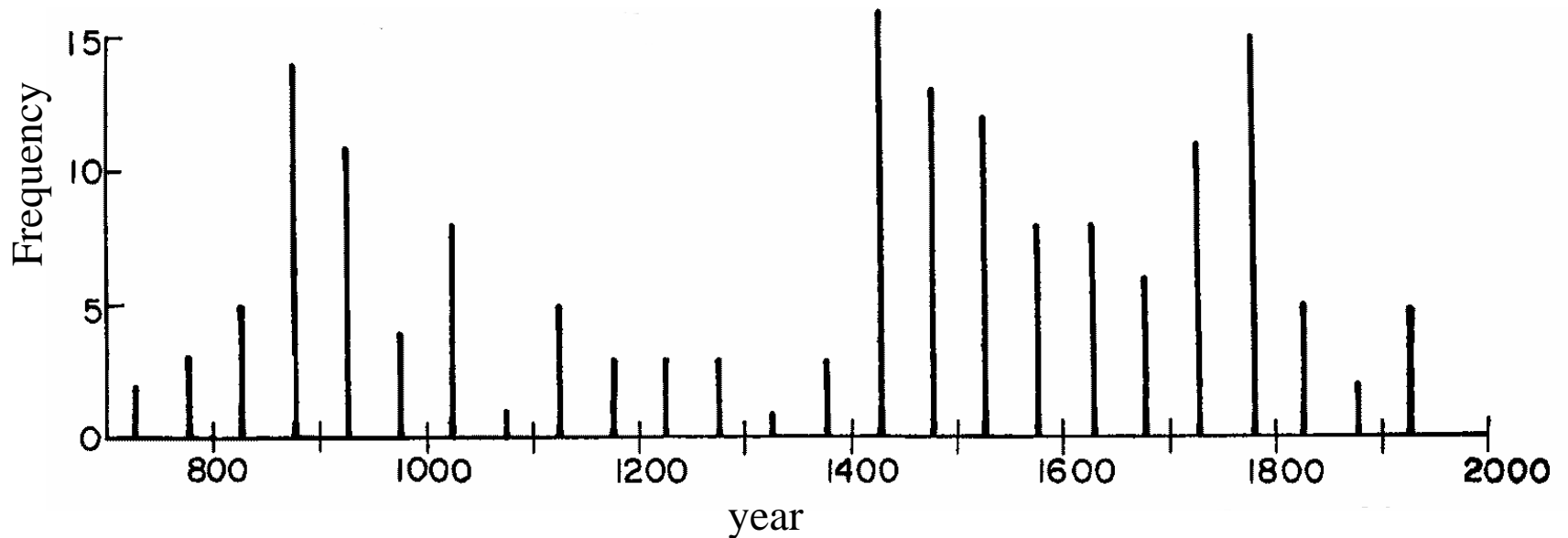
Located in the riparian flood plain

Disturbed by floods many times

Stopped to reach climax phase

Maintain the state dominated by *Ulmaceae* species

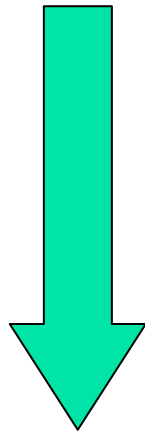
# Frequency of floods of Kamo River adjoining Tadasu-No-Mori Forest for every 50years



(Nakajima, 1983)

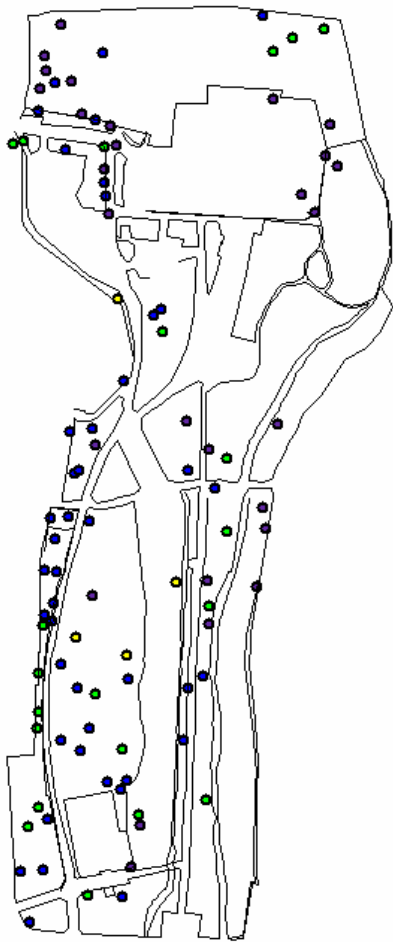
# The Latest Disturbance in Tadasu-No-Mori Forest

- Major typhoon had struck in 1934
- Massive flood had occurred in 1935



Most trees in Tadasu-No-Mori Forest had fallen

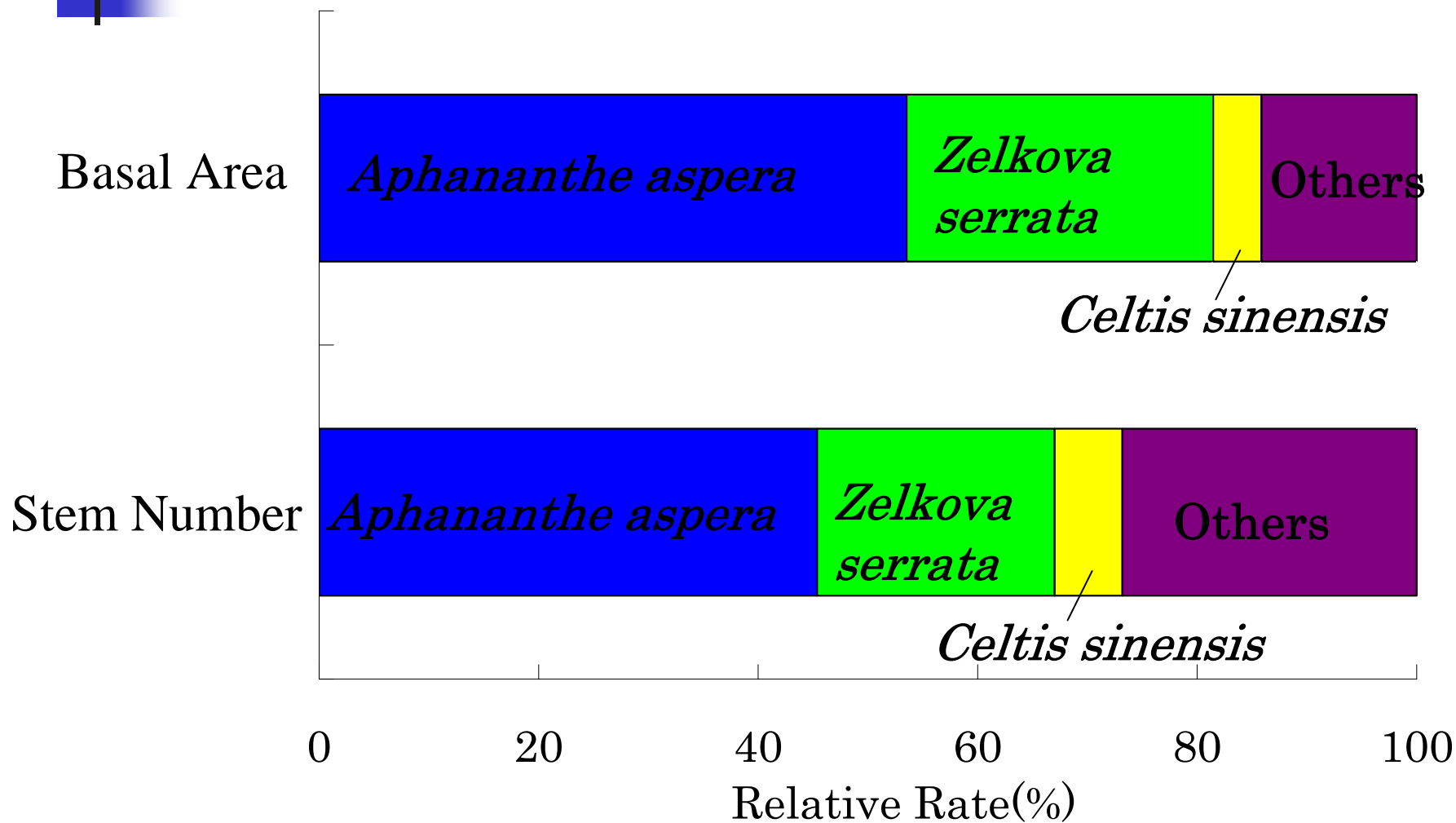
# The State of Tadasu-No-Mori Forest after 5 Years since the Latest Disturbance



All woody stems larger than or equal to 100cm GBH were censused (Ikeda, 1939)

- Number of stems: 97
- Stem density: 10.6 (/ha)
- Number of species: 18
- Total basal area: 0.08%

# The Structure of Tadasu-No-Mori Forest in 1939





# Human Impact on Tadasu-No-Mori Forest

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 After the latest disturbance

- Removal of natural disturbance process

Improvement of Rivers

- Introduction of non-native plant or competitive species against *Ulmaceae* species

- *Cinnamomum camphora*

- (non-native plant ,evergreen broad-leaved)

- *Quercus glauca* (evergreen broad-leaved)



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## Census Methods

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All woody stems larger than or equal to 10cm DBH  
(Except for Climbers)

- DBH (1.3 m above ground)
- Height
- Location
- Species

1st measurement: 1991

2nd measurement: 2002



# Structural Parameters

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	<b>1991</b>	<b>2002</b>
<b>Number of Species</b>	<b>56</b>	<b>59</b>
<b>Number of Stems</b>	<b>3416</b>	<b>3433</b>
<b>Stem Density (N/ha)</b>	<b>376.2</b>	<b>378.1</b>
<b>Basal Area (%)</b>	<b>0.37</b>	<b>0.40</b>

(larger than or equal to 10cm DBH)



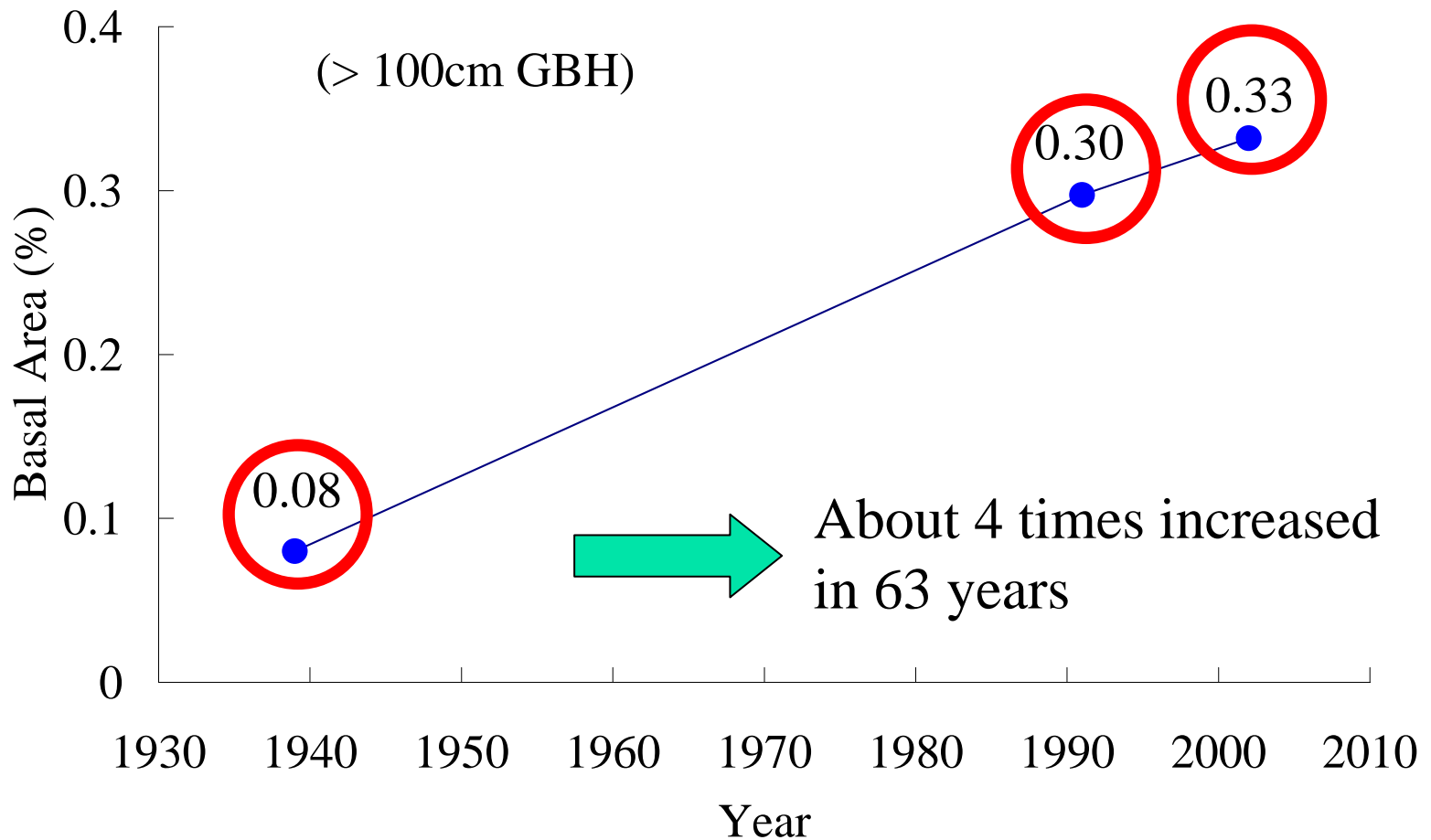
# Mortality and Recruitment Rate

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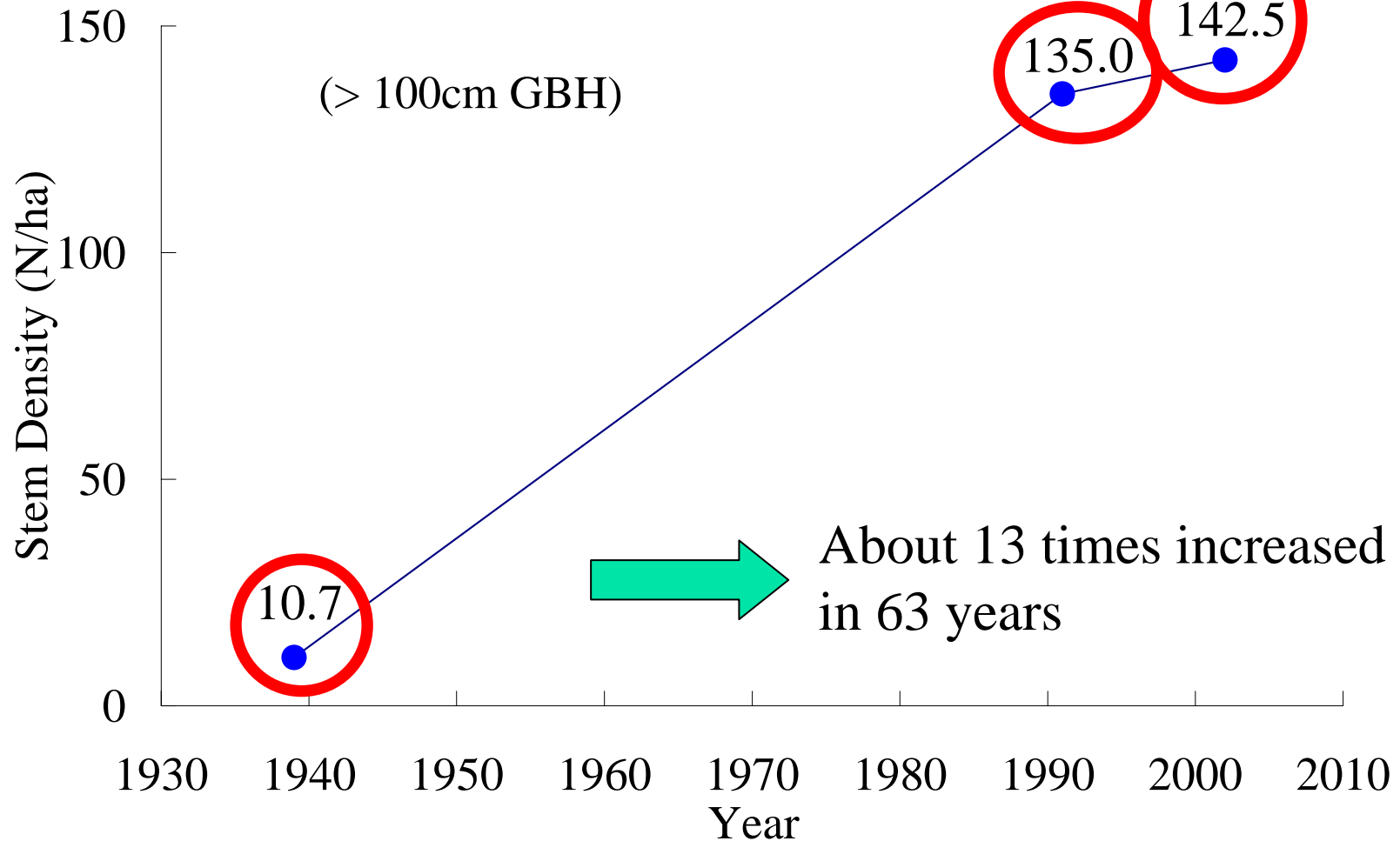
Species	Mortality Rate (%/yr)	Recruitment Rate %/yr
Total	1.3	1.2
<i>Quercus glauca</i>	1.2	2.0
<i>Aphananthe aspera</i>	0.3	0.3
<i>Celtis sinensis</i>	1.3	0.3
<i>Cinnamomum camphora</i>	0.5	0.2
<i>Zelkova serrata</i>	1.5	0.2

(larger than or equal to 10cm DBH)

# Change of Total Basal Area

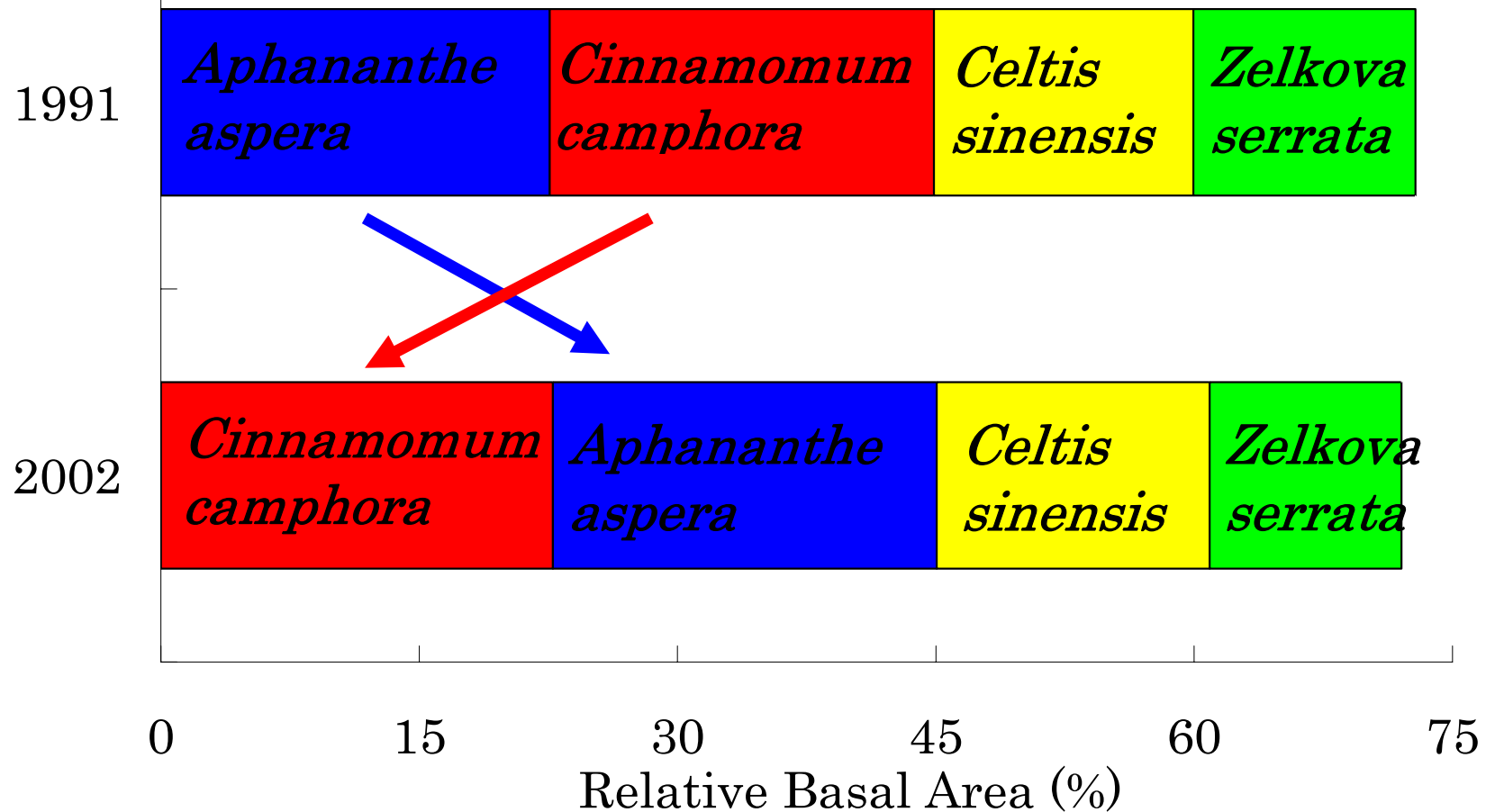


# Change of Stem Density



# Relative Rate of Basal Area

(larger than or equal to 10cm DBH)





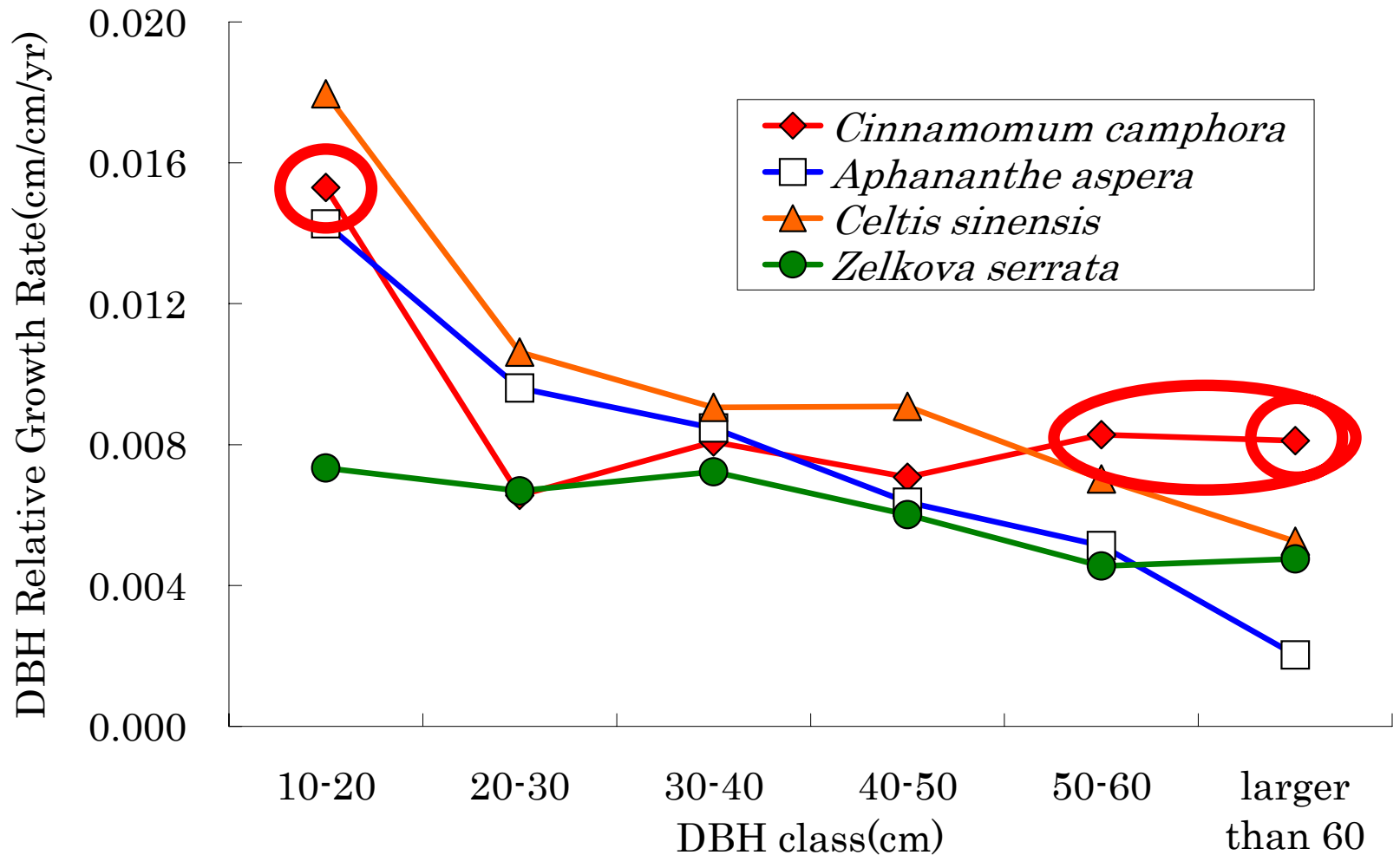
# Comparison of Traits among four main species

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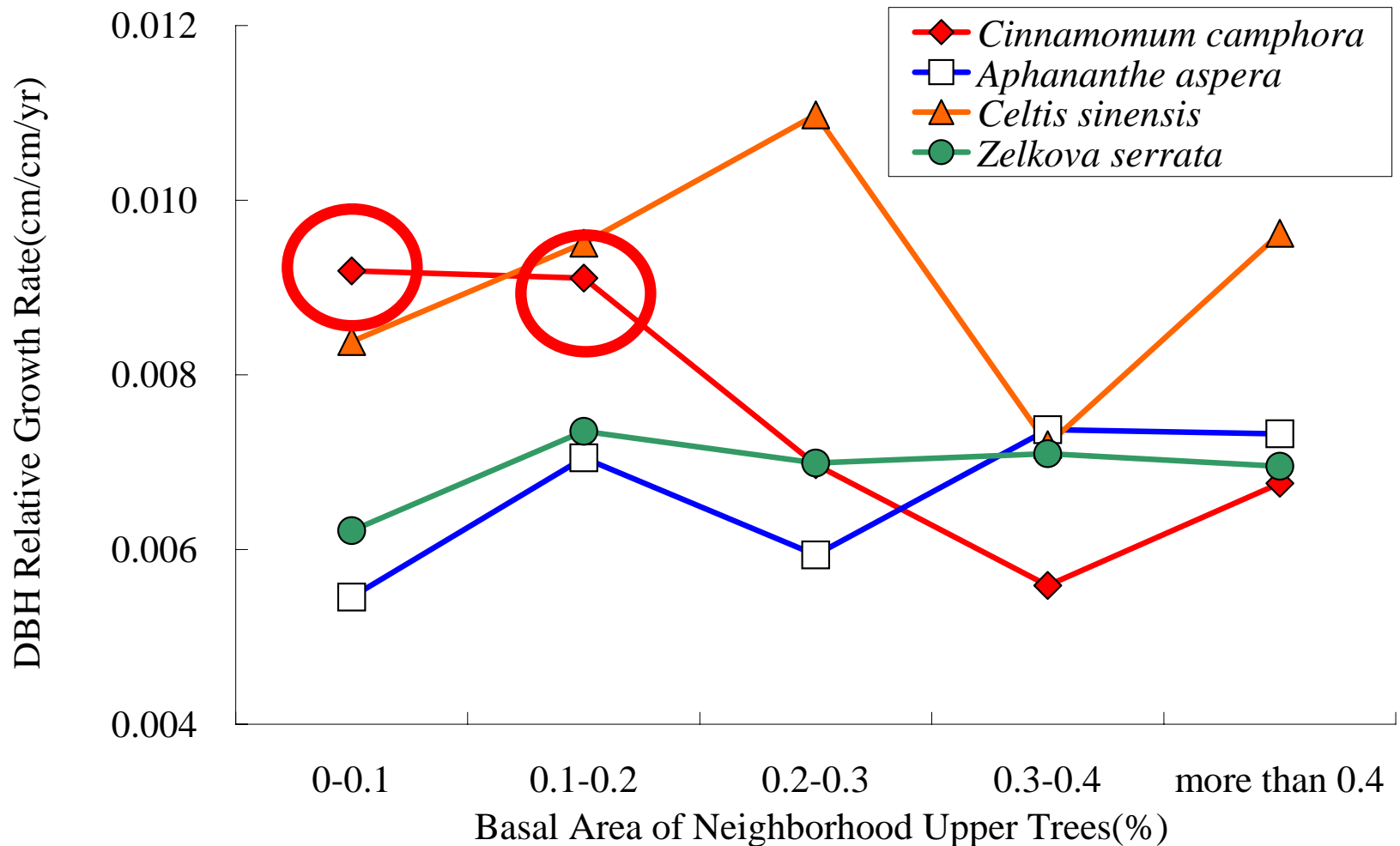
- *Cinnamomum camphora* (*Lauraceae* ,Evergreen)
- *Aphananthe aspera* (*Ulmaceae*, deciduous)
- *Celtis sinensis* (*Ulmaceae*, deciduous )
- *Zelkova serrata* (*Ulmaceae*, deciduous)

Growth Rate and Mortality Rate of these species were compared with each other

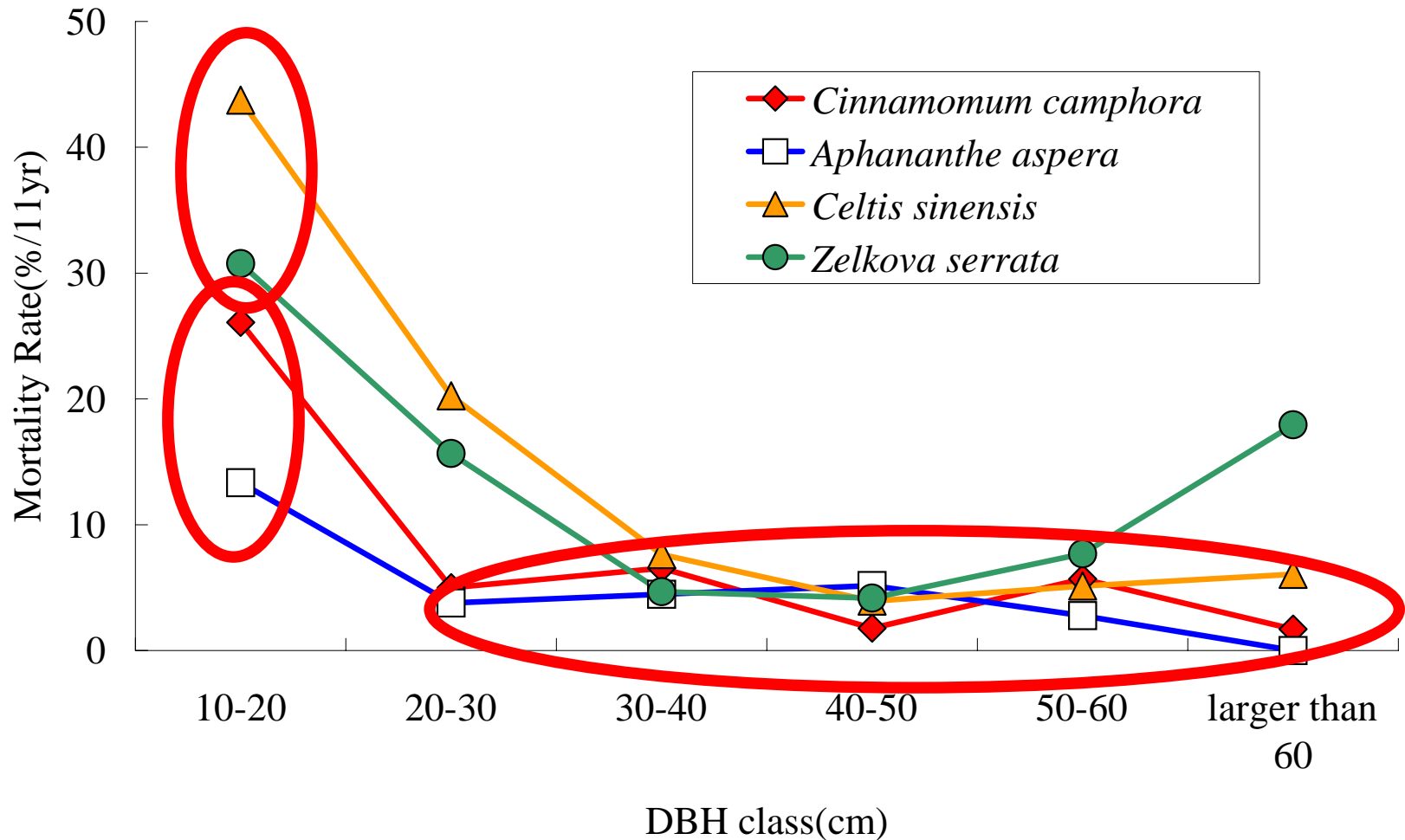
# Relation Between Size and Growth Rate



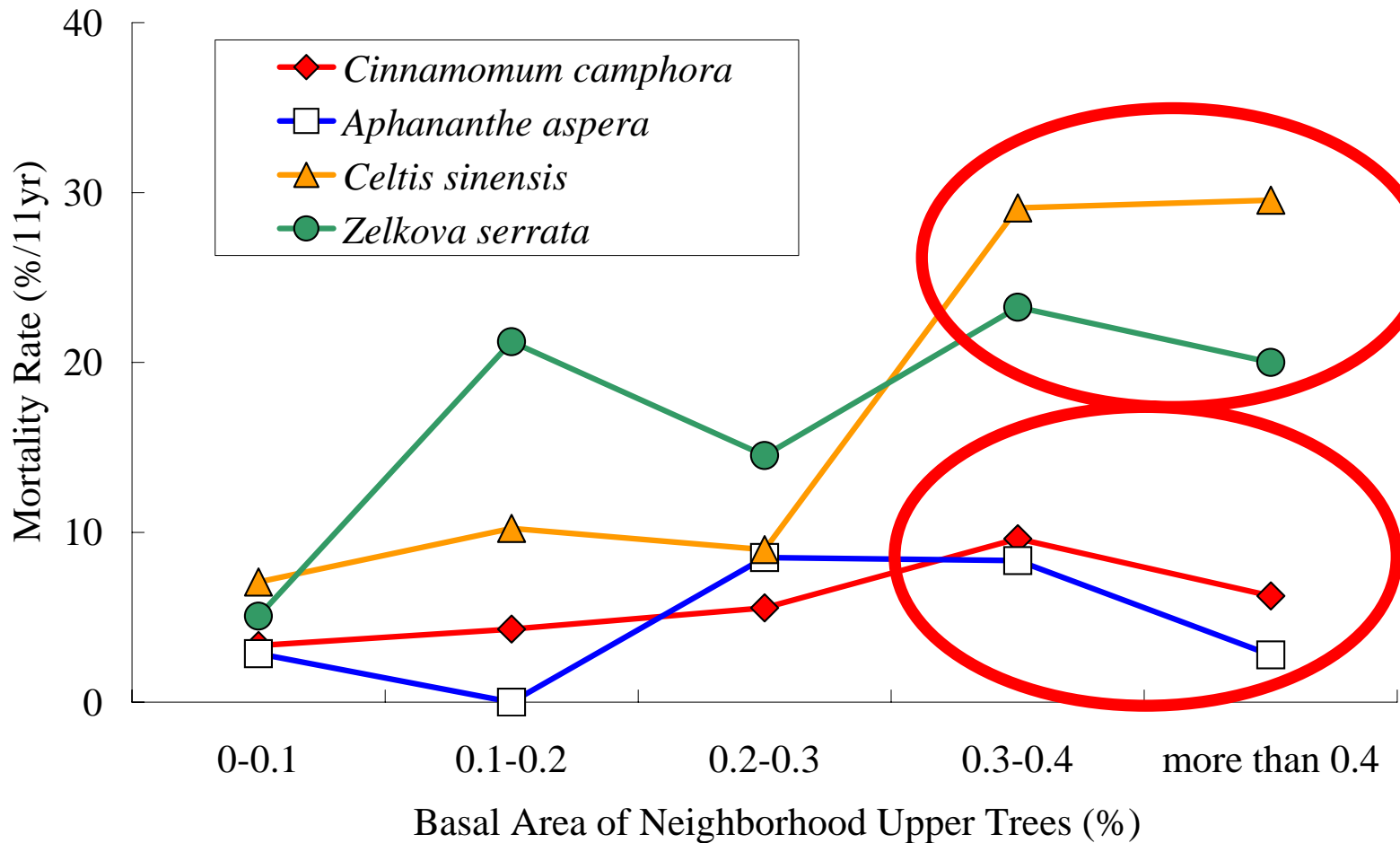
# Relation Between degree of suppression and Growth Rate



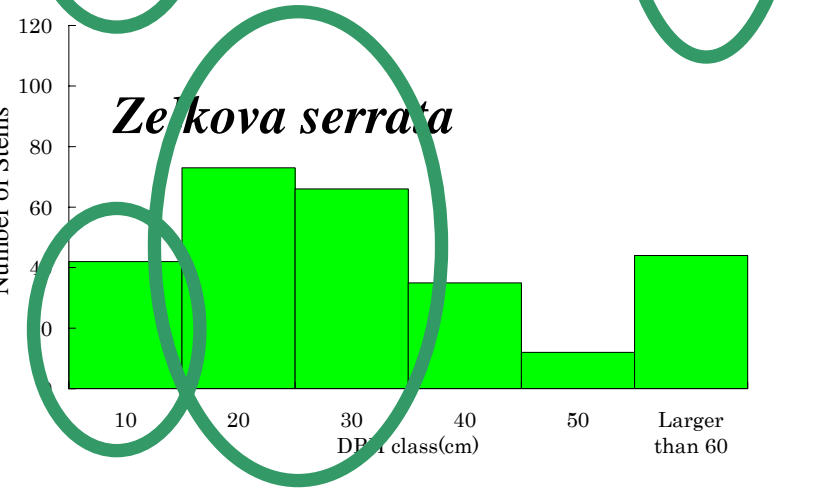
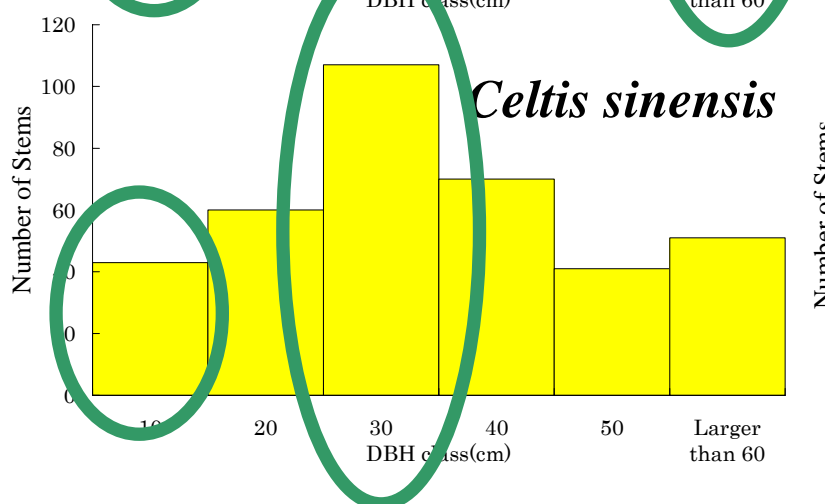
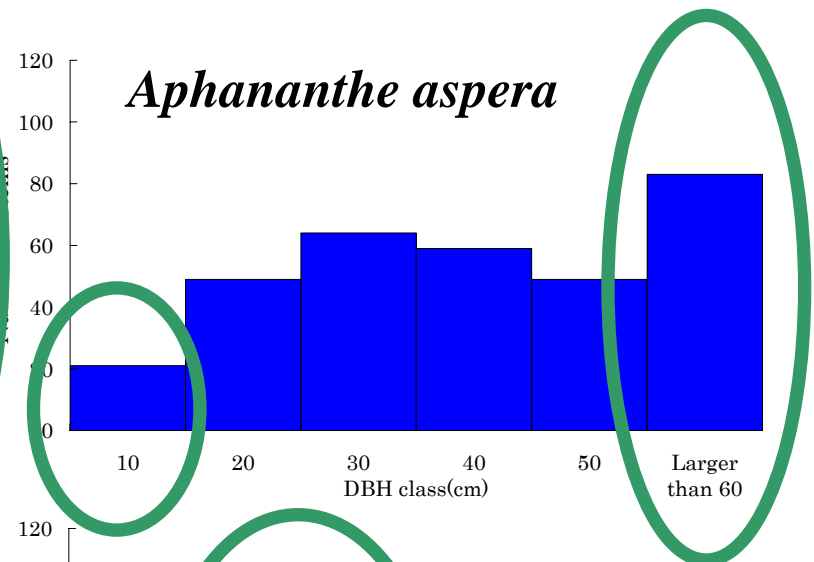
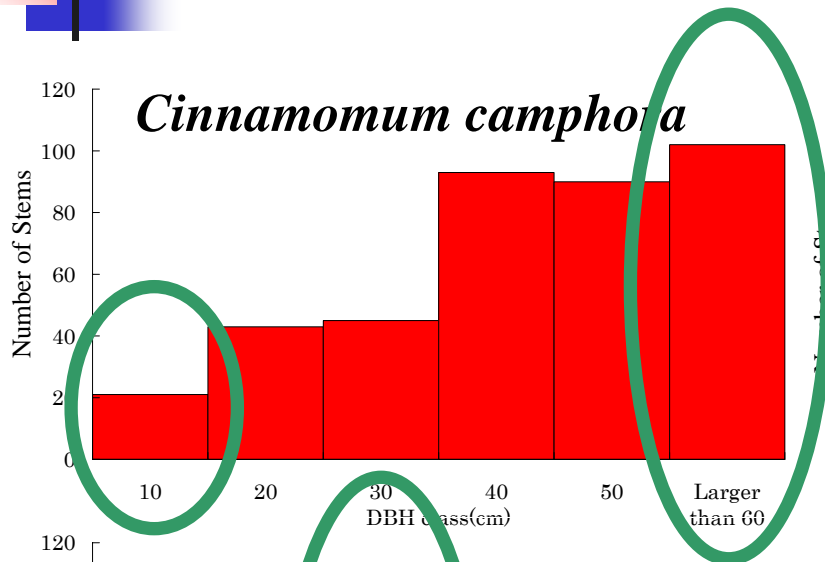
# Relation Between Size and Mortality Rate



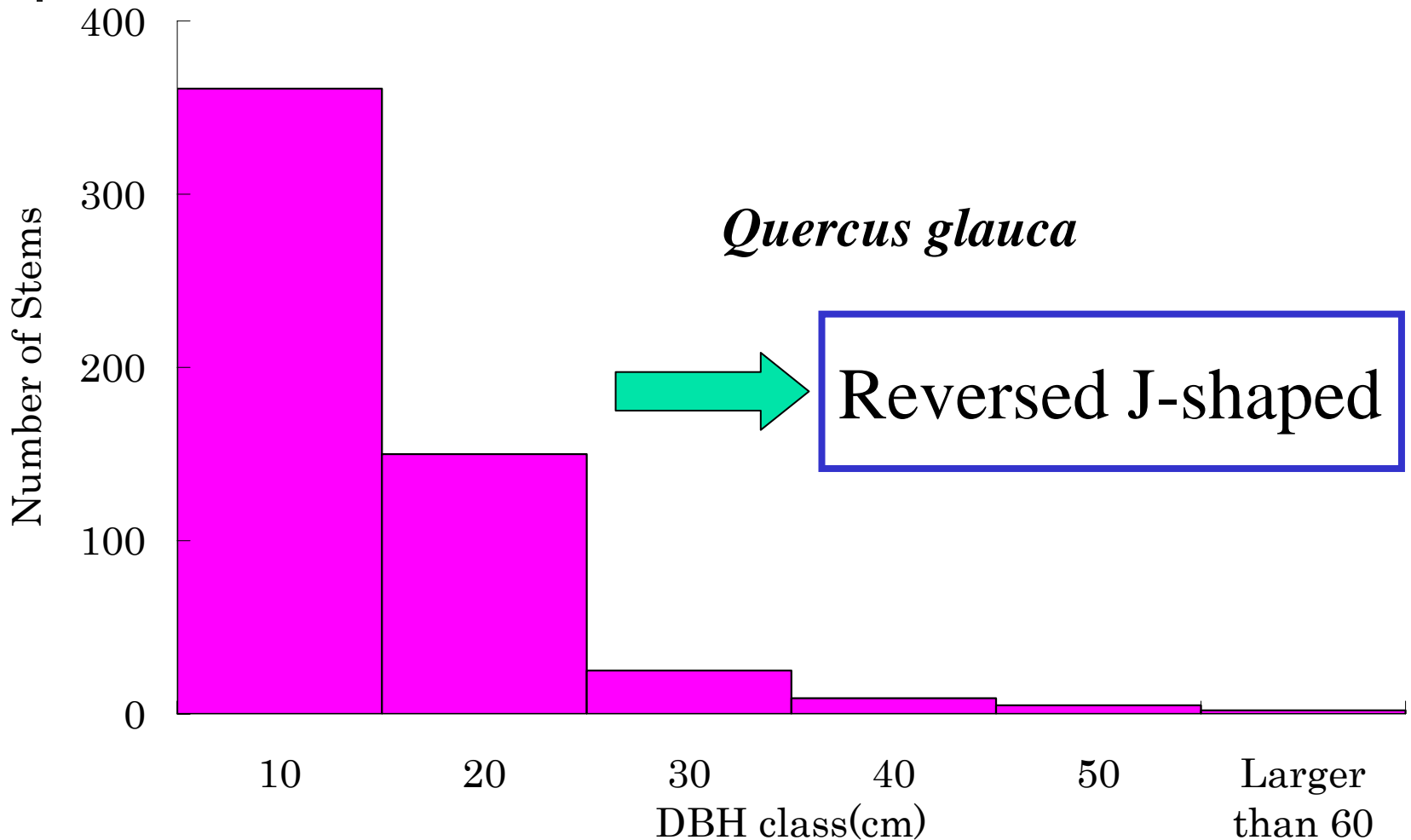
# Relation Between Degree of Suppression and Mortality Rate

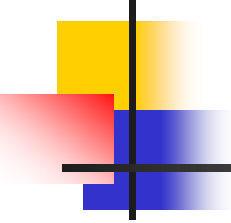


# DBH Frequency Distribution in 2002

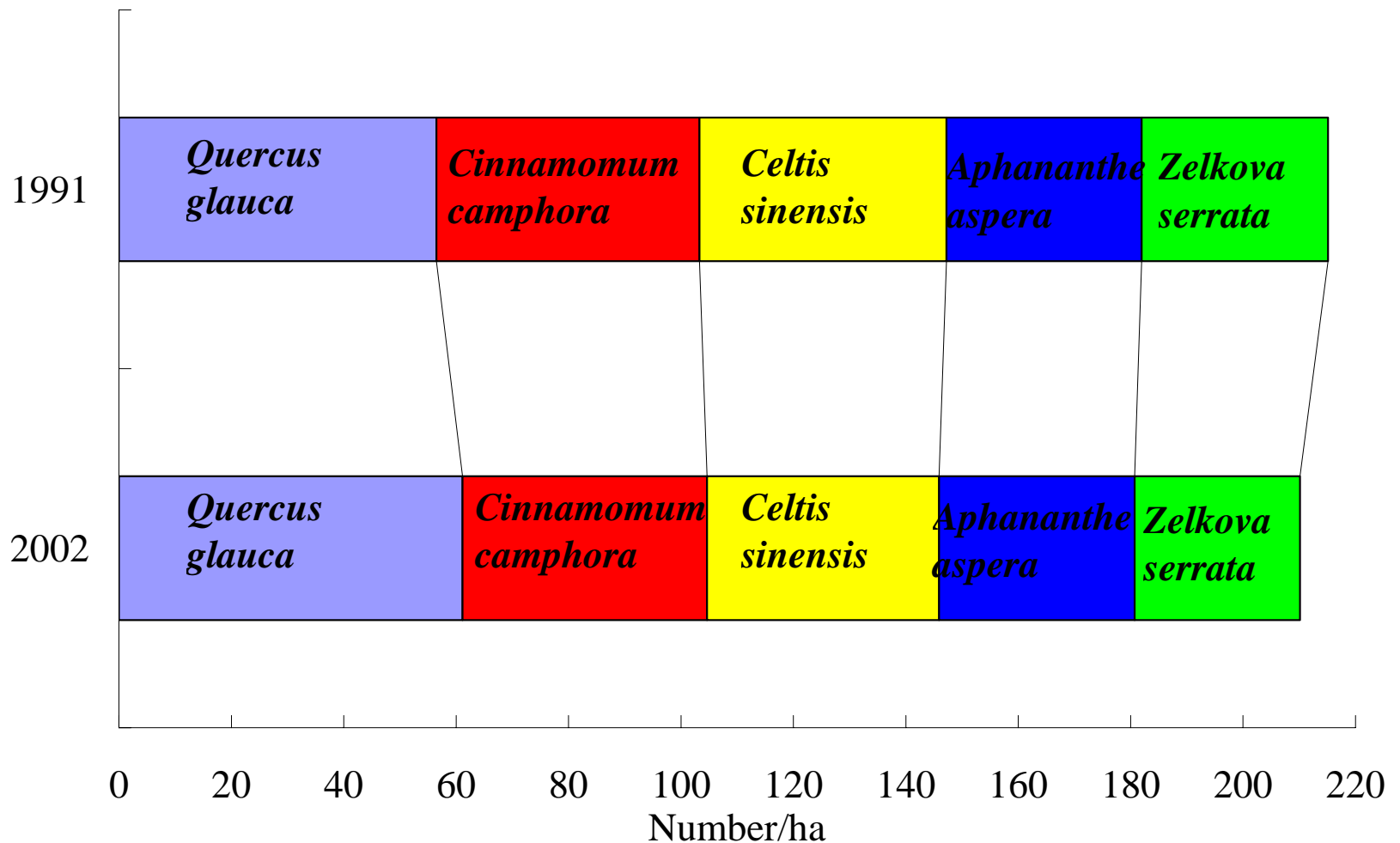


# DBH Frequency Distribution in 2002





# Stem Density (larger than or equal to 10cm DBH)





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# Summary & Future plan

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## Summary

- *Cinnamomum camphora*, non-native species, will maintain the most dominant position for the time being
- In the further future, *Quercus glauca* will take the place of *Cinnamomum camphora*.

## Future plans

- We continue to census in this site at regular intervals and examine the influences of human activity on this forest