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

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Important roles of Urban Forests

- 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

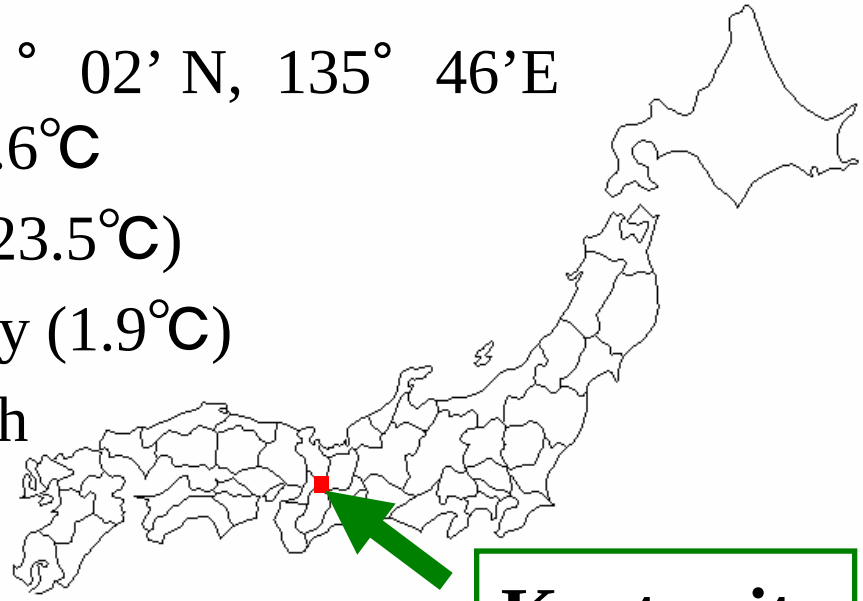
Intact woods in urban area remains as shrine forests

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

Tadasu-No-Mori Forest

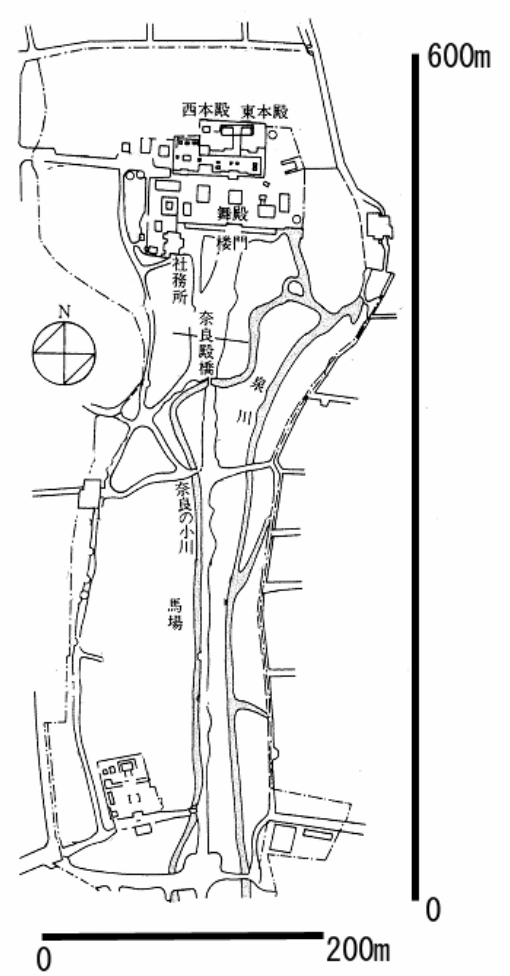
Location of Study site - Kyoto city -

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



- 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

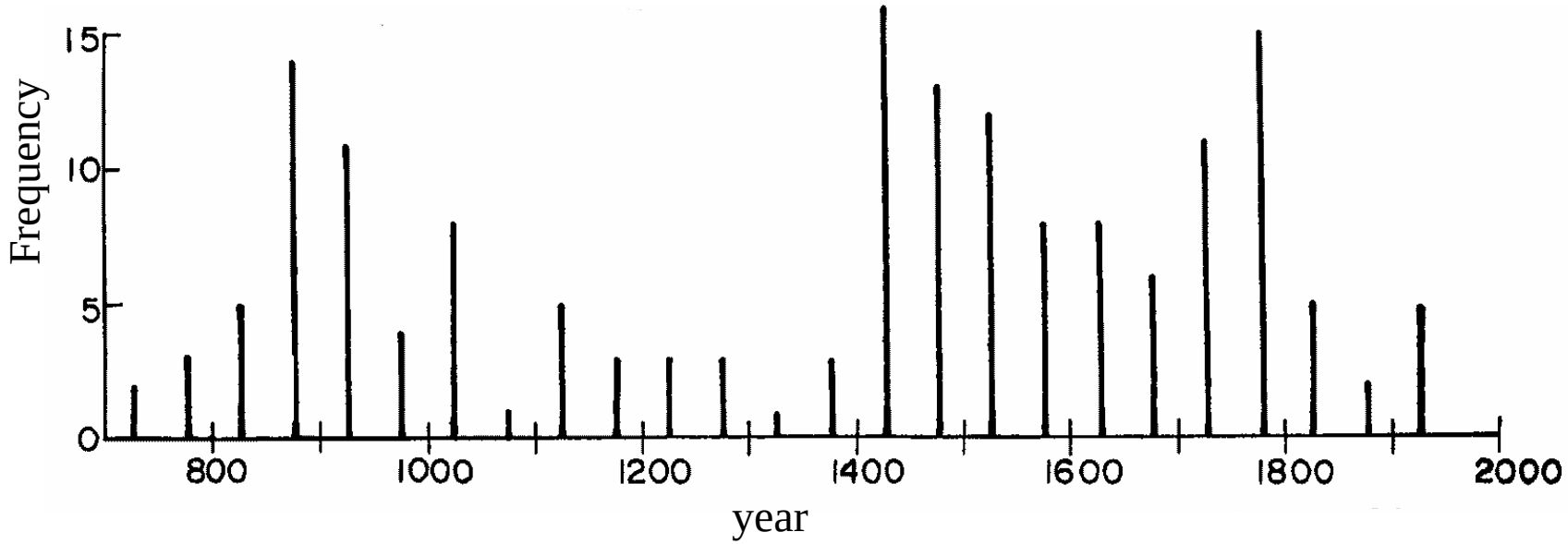
Located in the riparian flood plain

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



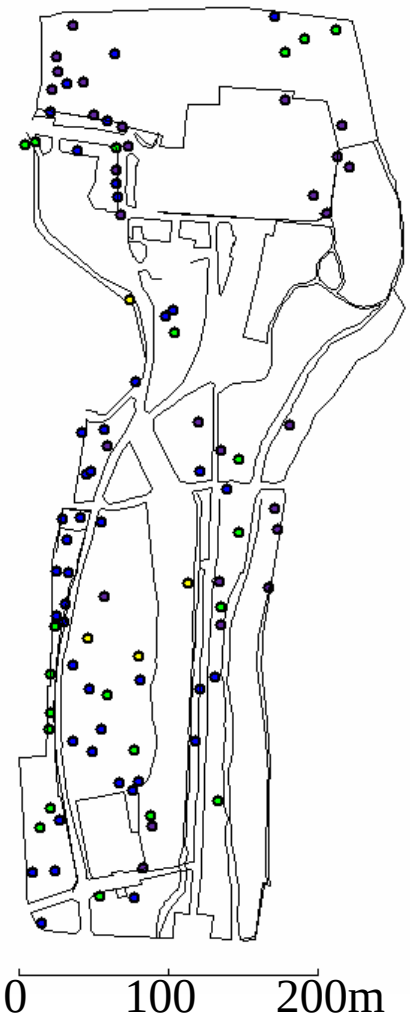
(Nakajima, 1983)

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

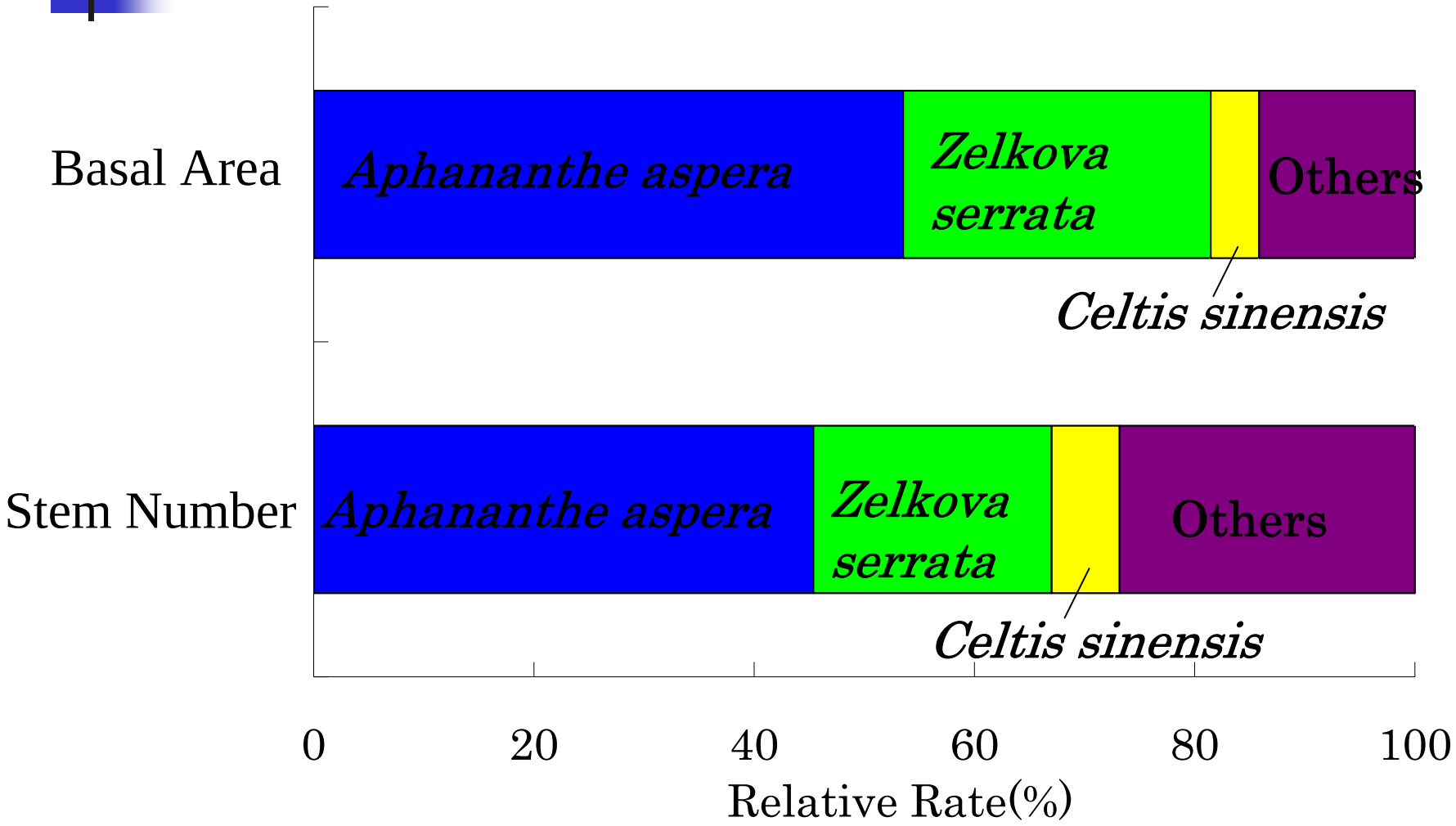
The State of Tadasu-No-Mori Forest after 5 Years since the Latest Disturbance



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

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

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

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

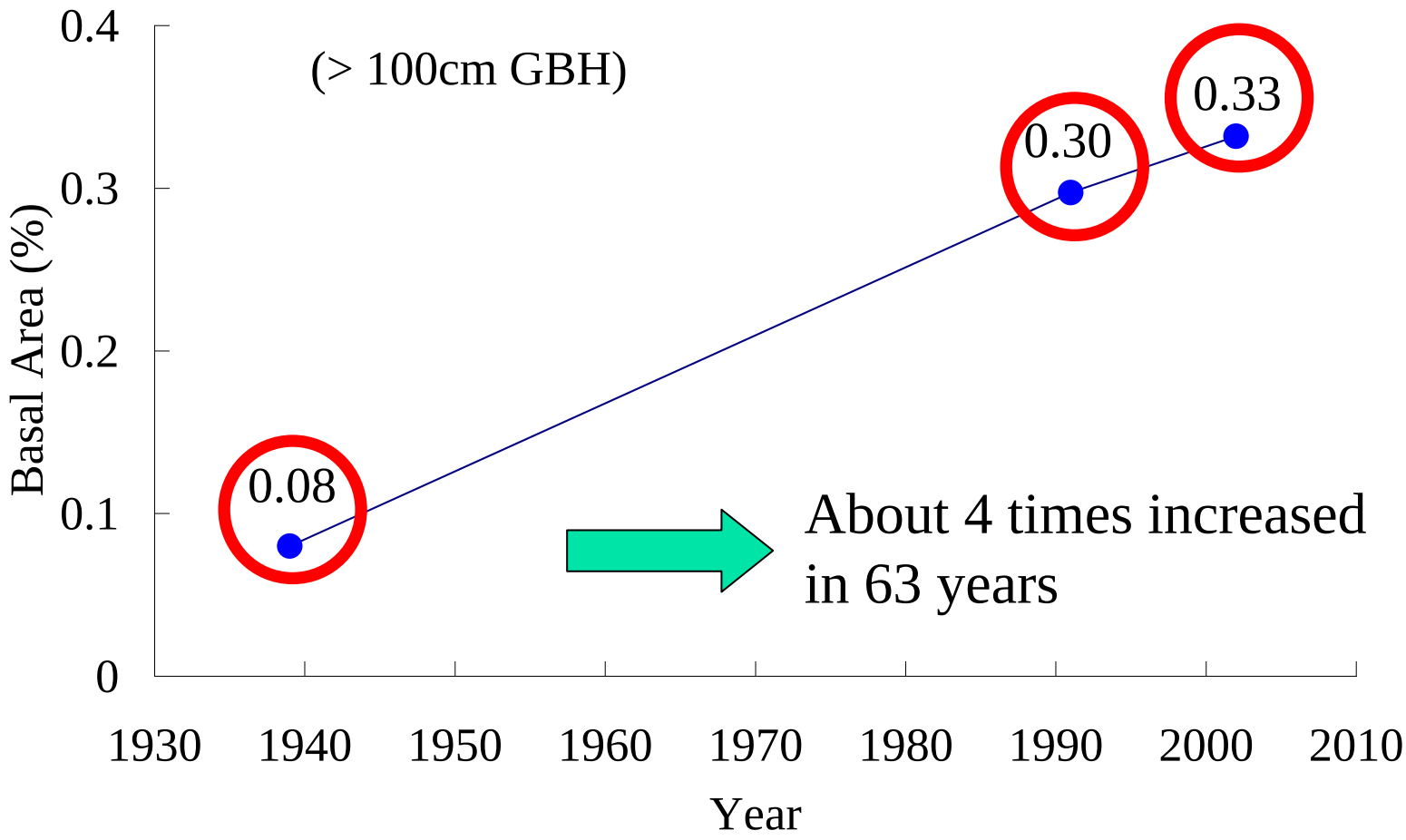
(larger than or equal to 10cm DBH)

Mortality and Recruitment Rate

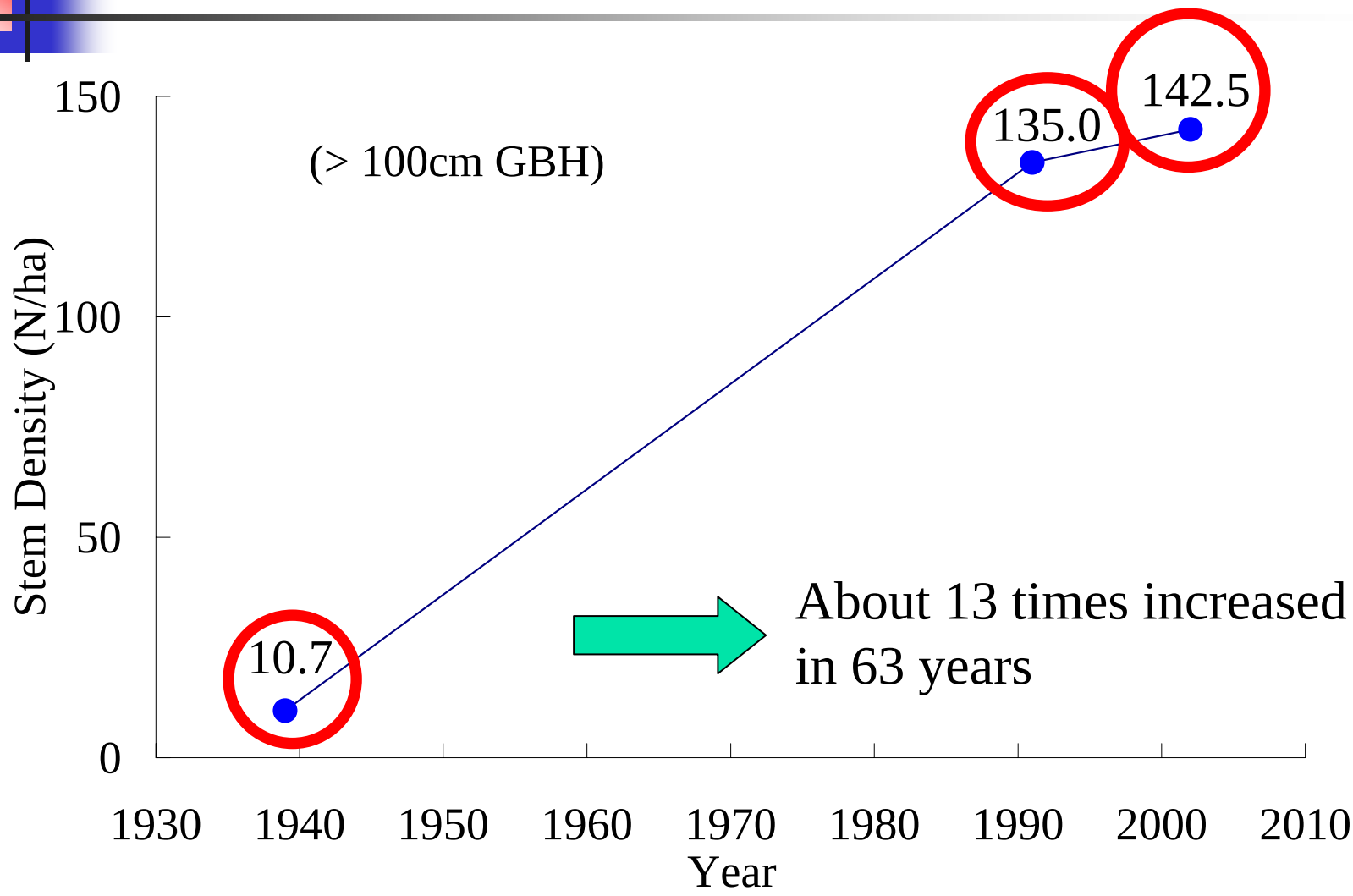
Species	Mortality Rate (%/yr)	Recruitment Rate (%/yr)
Total	1.3	1.2
Quercus glauca	1.2	2.0
Aphananthe aspera	0.3	0.3
Celtis sinensis	1.3	0.3
Cinnamomum camphora	0.5	0.2
Zelkova serrata	1.5	0.2

(larger than or equal to 10cm DBH)

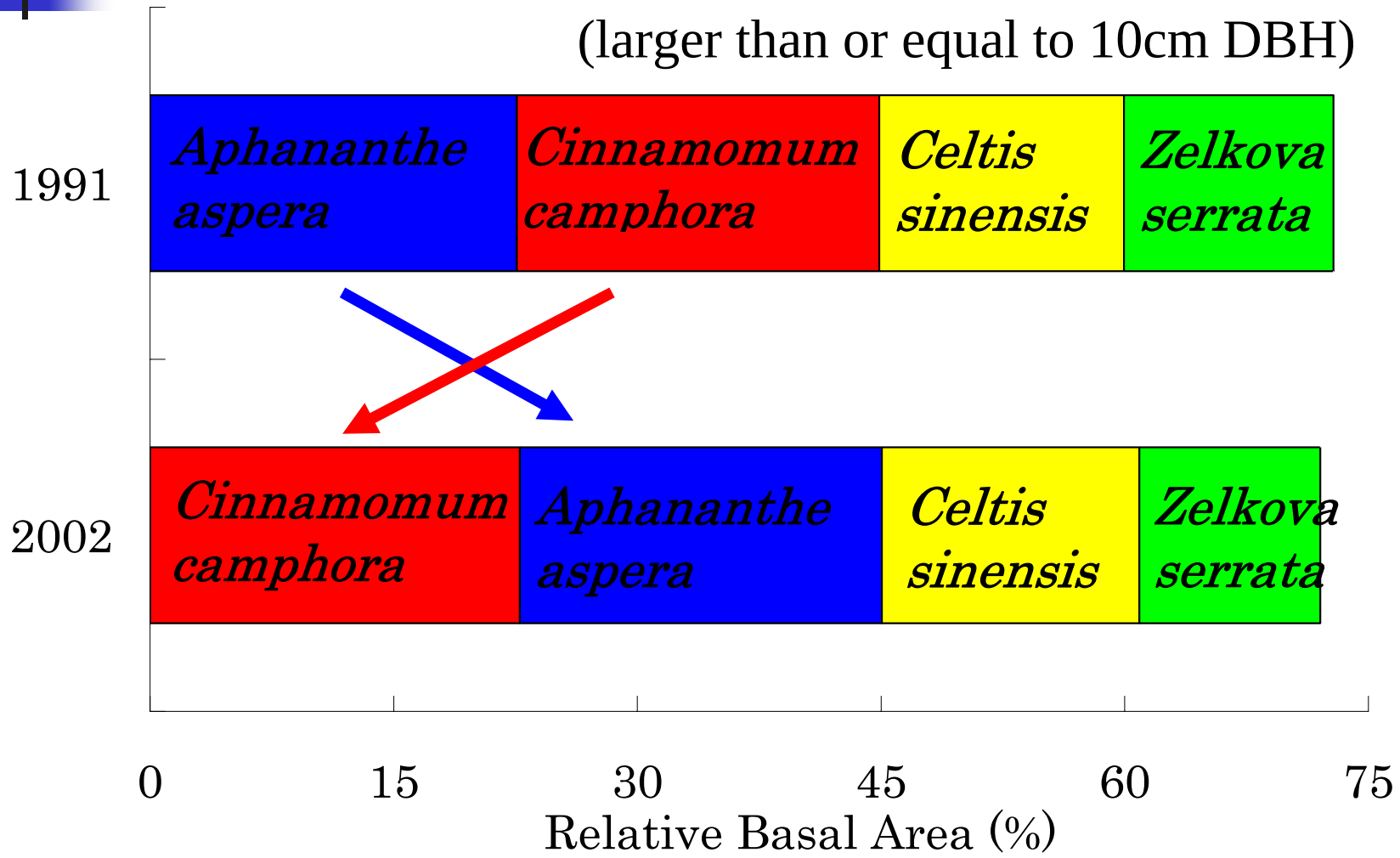
Change of Total Basal Area



Change of Stem Density



Relative Rate of Basal Area

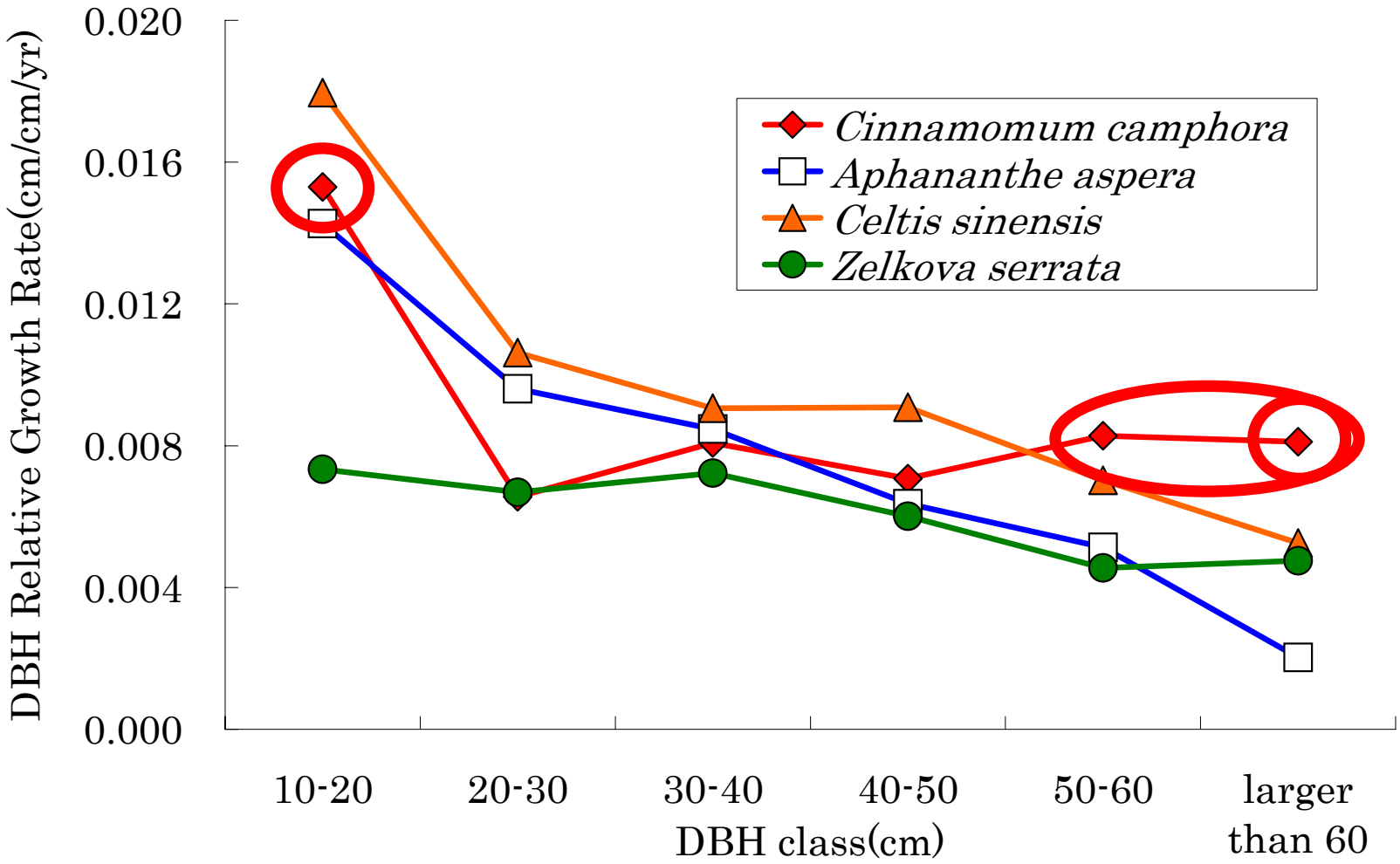


Comparison of Traits among four main species

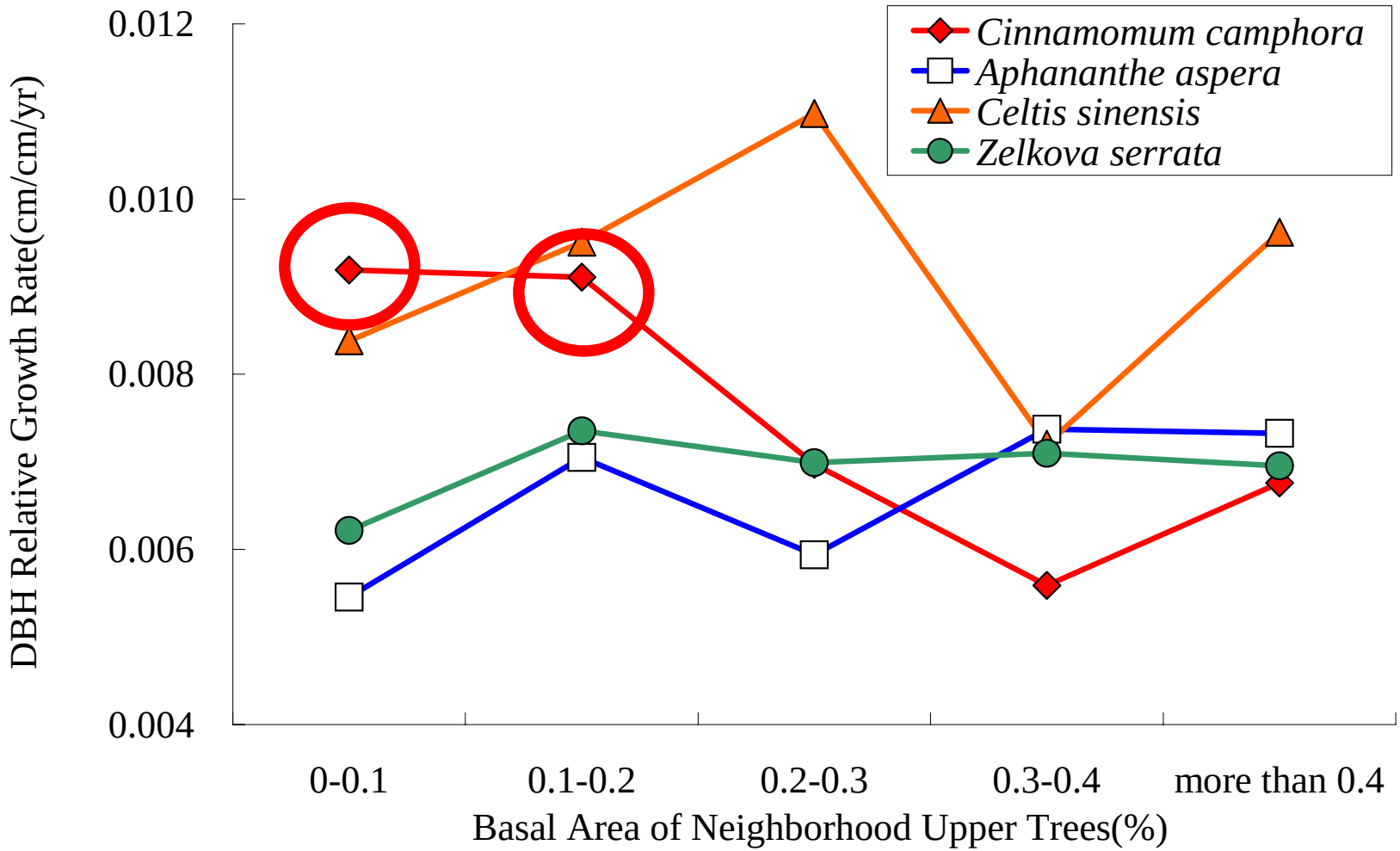
- *Cinnamomum camphora* (*Lauraceae* ,Evergreen)
- *Aphananthe aspera* (*Ulmaceae*, deciduous)
- *Celtis sinensis* (*Ulmaceae*, deciduous)
- *Zelkova serrata* (*Ulmaceae*, deciduous)

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

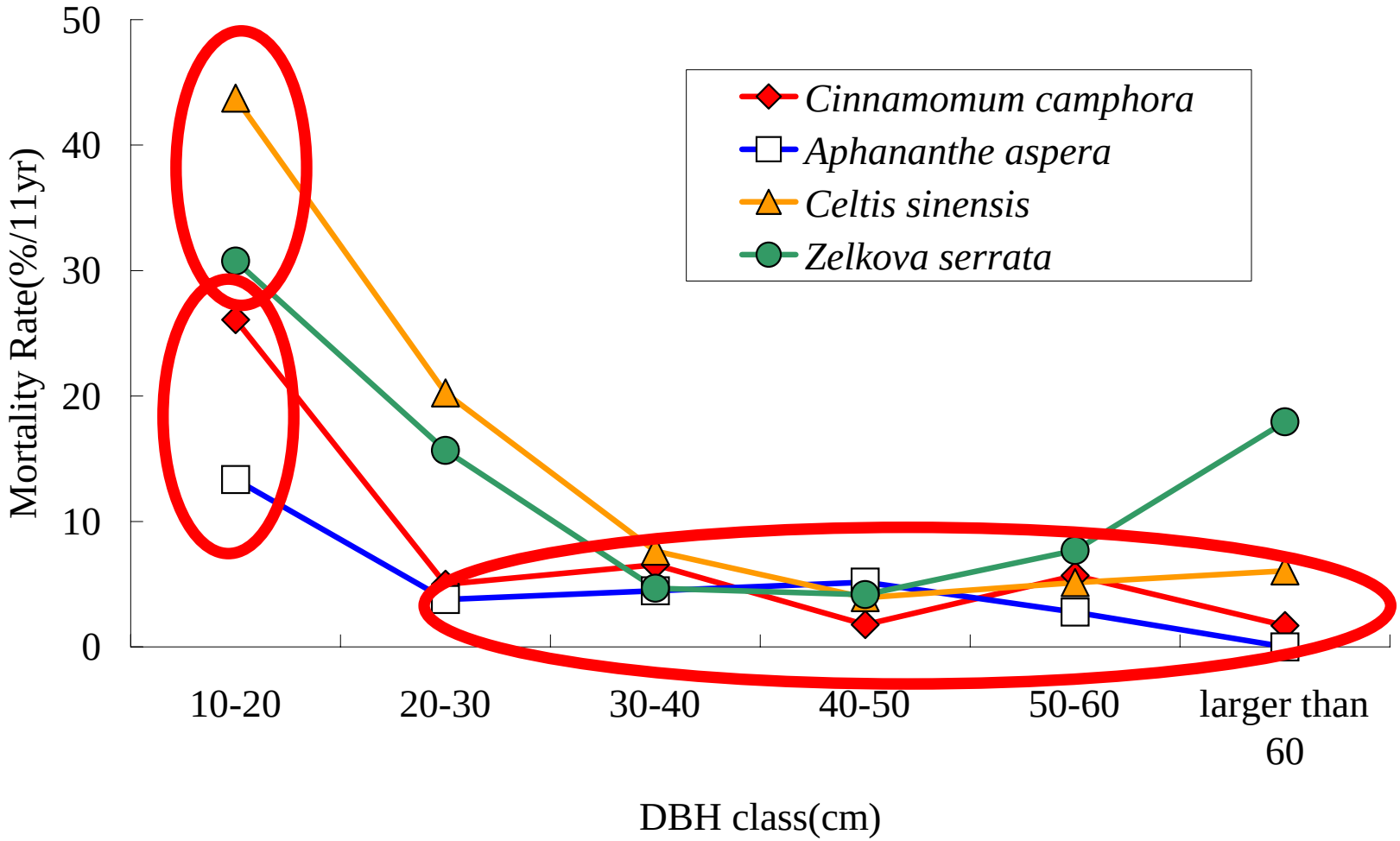
Relation Between Size and Growth Rate



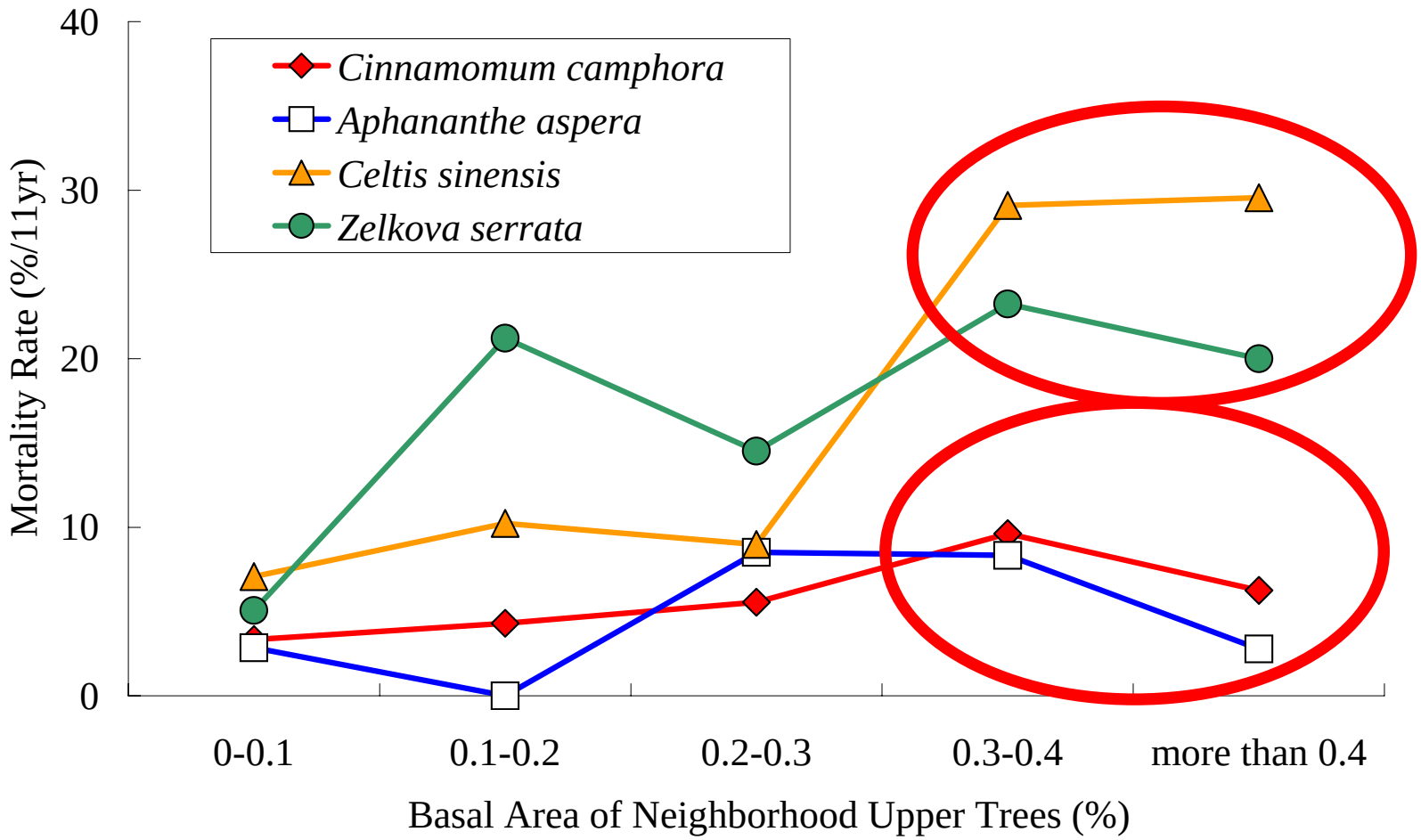
Relation Between degree of suppression and Growth Rate



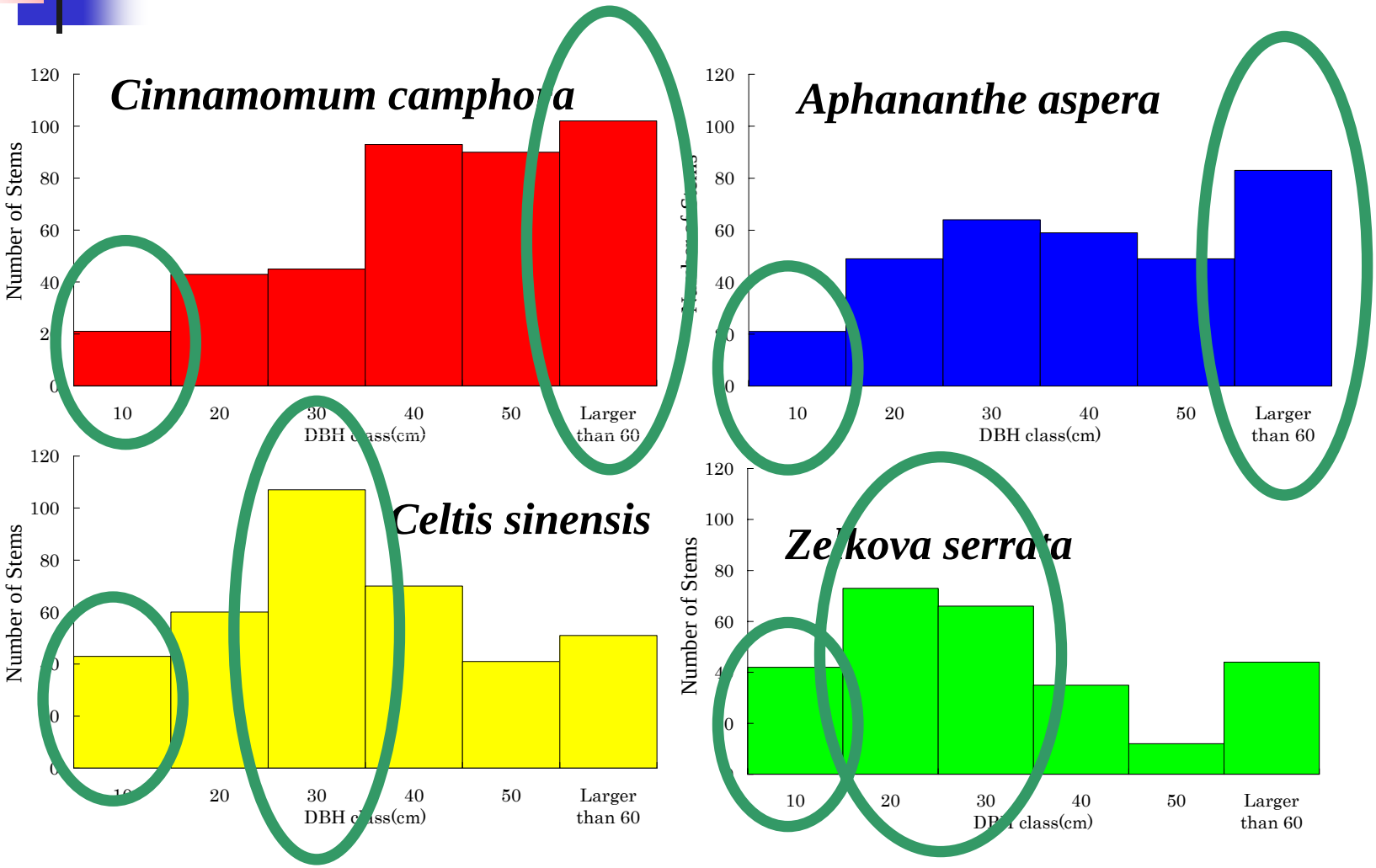
Relation Between Size and Mortality Rate



Relation Between Degree of Suppression and Mortality Rate



DBH Frequency Distribution in 2002



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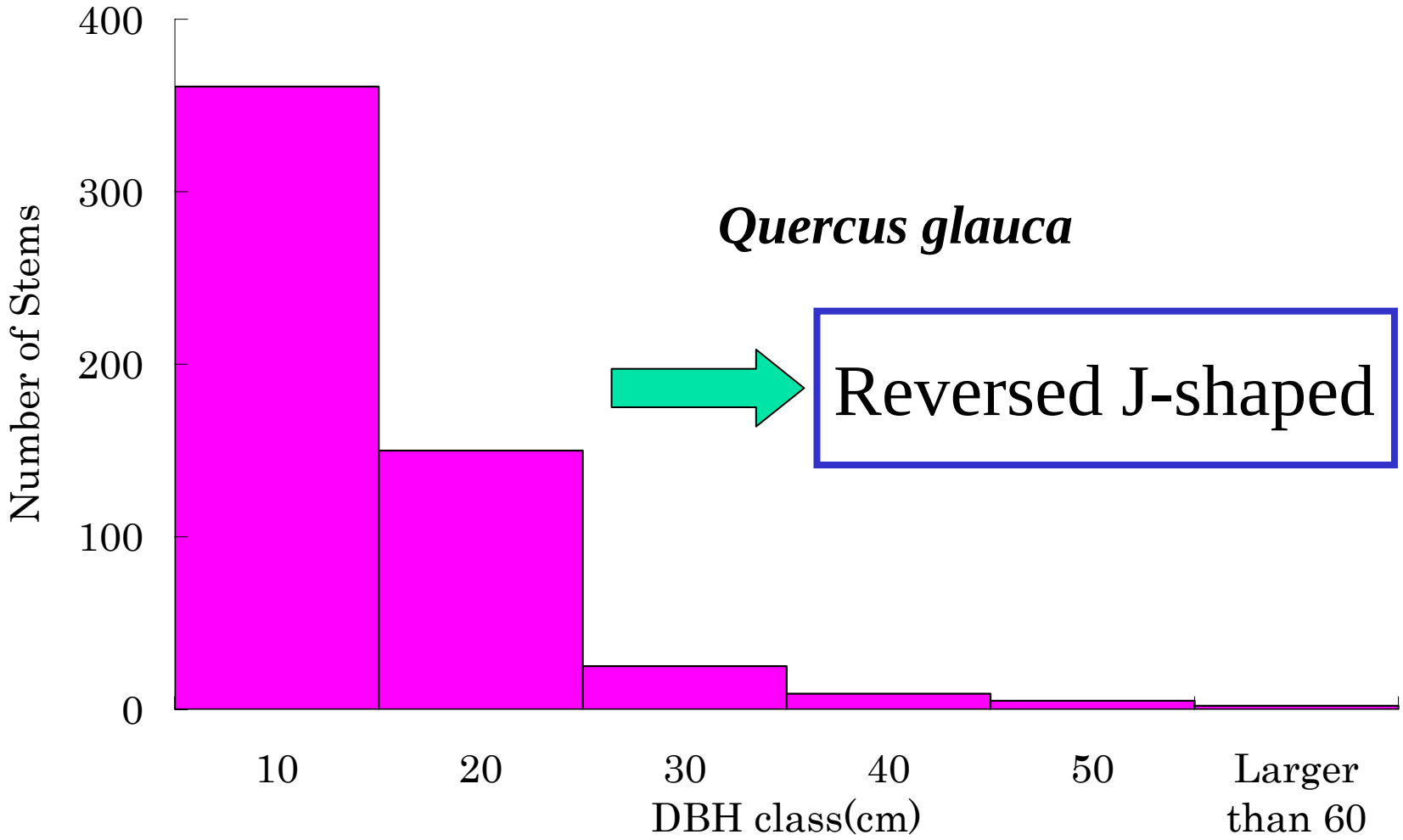
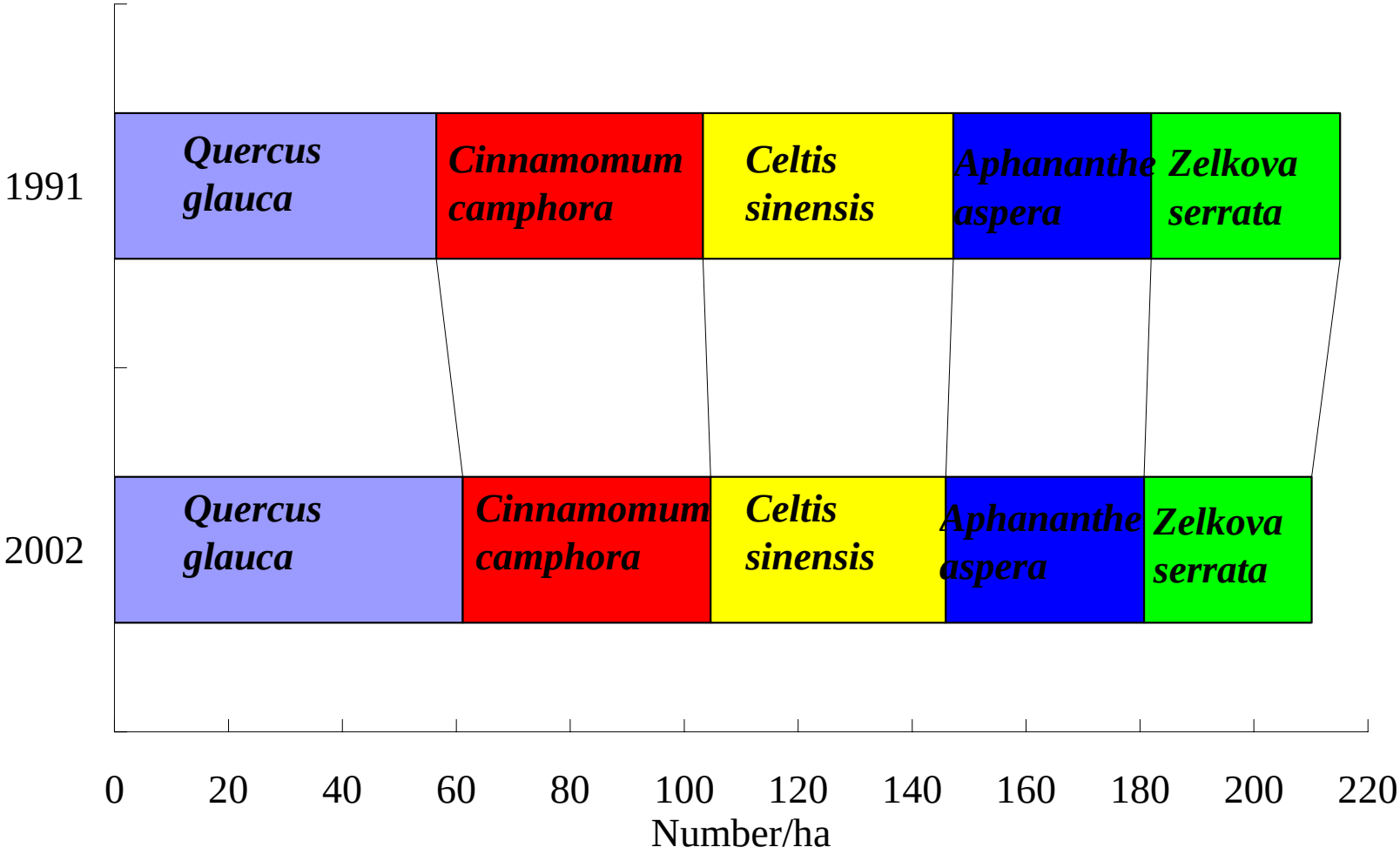


Stem Density (larger than or equal to 10cm DBH)



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Summary & Future plan

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