Ground-based measurements of leaf area index in forests

Definition of Leaf Area Index

"The LAI is half the total foliage (surface) area per unit ground surface area"

(Chen & Black 1991)

Estimation of LAI with non-destructive methods

1. Litter collection

- Determination of specific leaf area (cm^2/g)
- Calculation of leaf area collected in the litter traps

2. Inclined point quadrat

- Piercing the canopy with a needle
- Counting number of contacts

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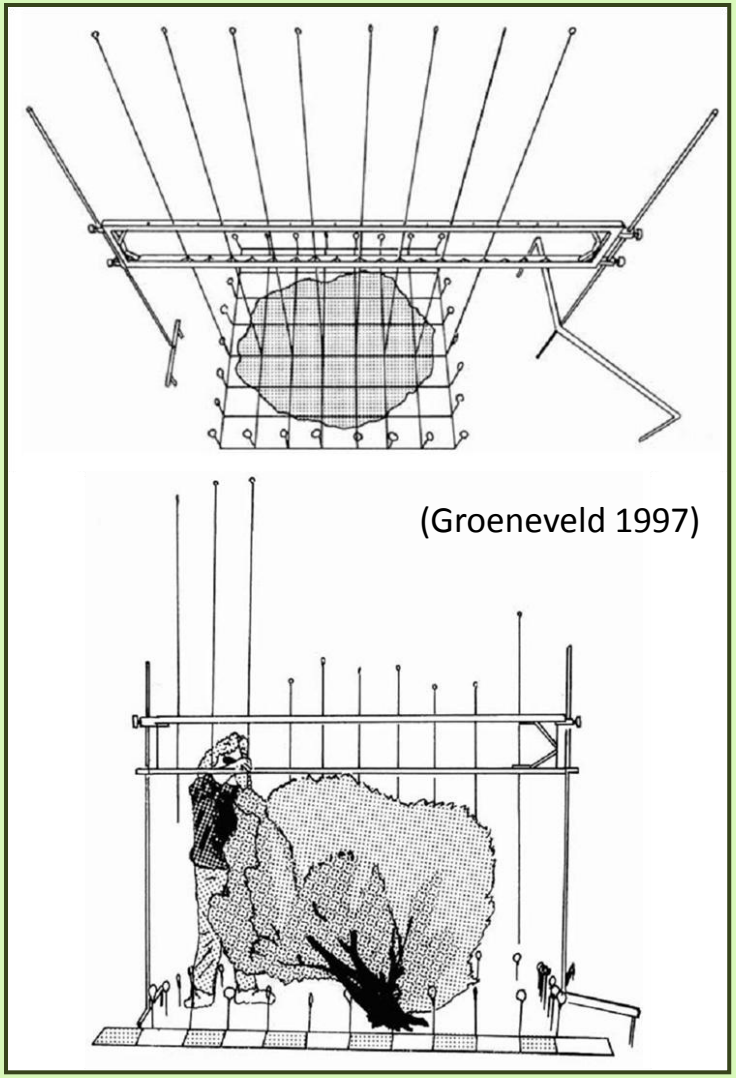


(Groeneveld 1997)

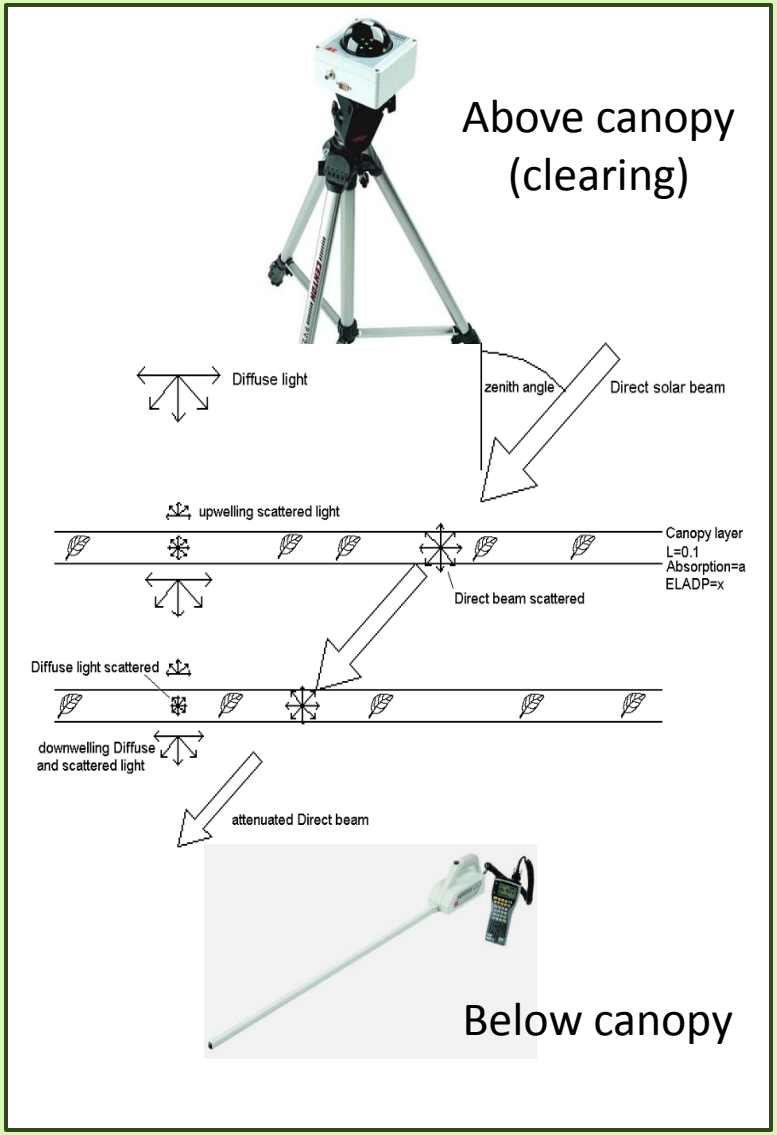
Estimation of LAI with non-destructive methods

3. Light Absorption (SunScan)

- The needle is replaced by solar beam
- Measuring light intensity above and below the canopy
- Calculation of absorption by contacts with canopy elements

4. Gapfraction (Hemispherical Photography & LAI-2000)

- Probability for a solar beam to pass the canopy without contact
- LAI is calculated the assumption that:
  - Leafs are randomly distributed
  - Leafs don't transmit light



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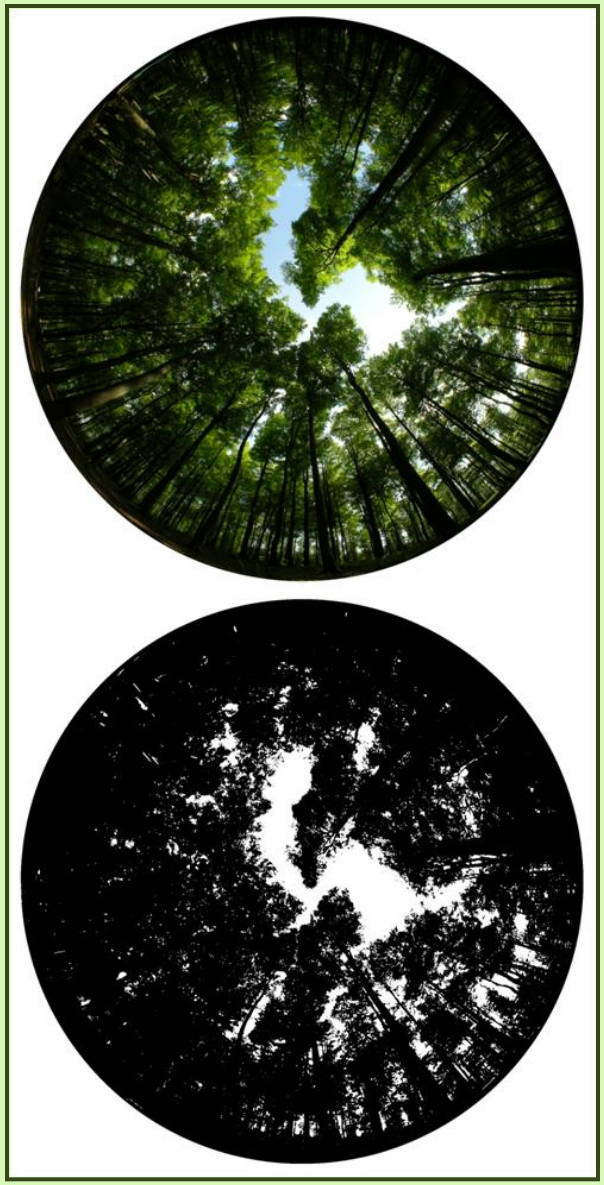
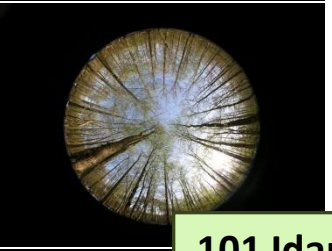
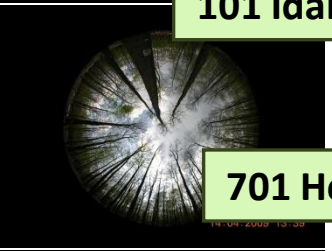
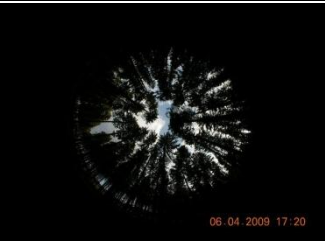


Study sites Rhineland-Palatinate





Altenkirchen
Koblenz
Lahn
Daun
Rhein
Mainz
Bitburg
Mosel
Thier
Idar Oberstein
Nahe
Saar
Ludwigshafen
Kaiserslautern
Neustadt/Wstr.
Pirmasens

704 Neuhäusel (2)

101 Idar-Oberstein

703 Donnersberg

701 Hermeskeil

707 Johanniskreuz

501 Merzalben (3)

706 Hagenbach

705 Merzalben (2)

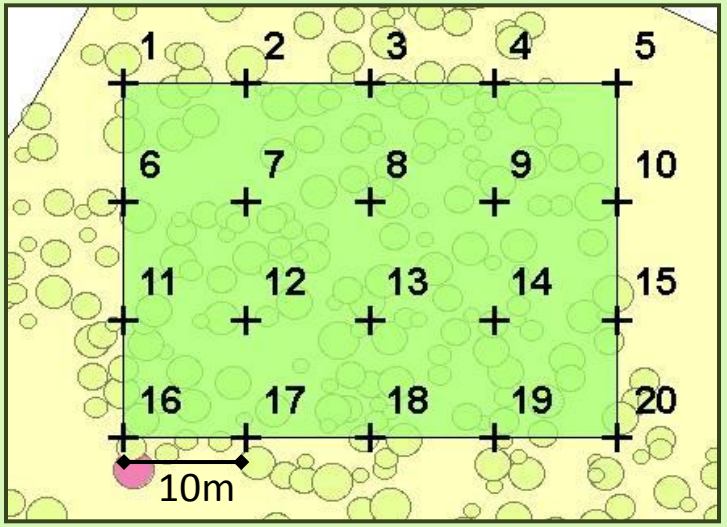
2x	Norway spruce
3x	Oak / Beech
1x	Scots Pine / Beech
4x	Beech
1x	Douglas-fir / Beech
1x	Douglas-fir

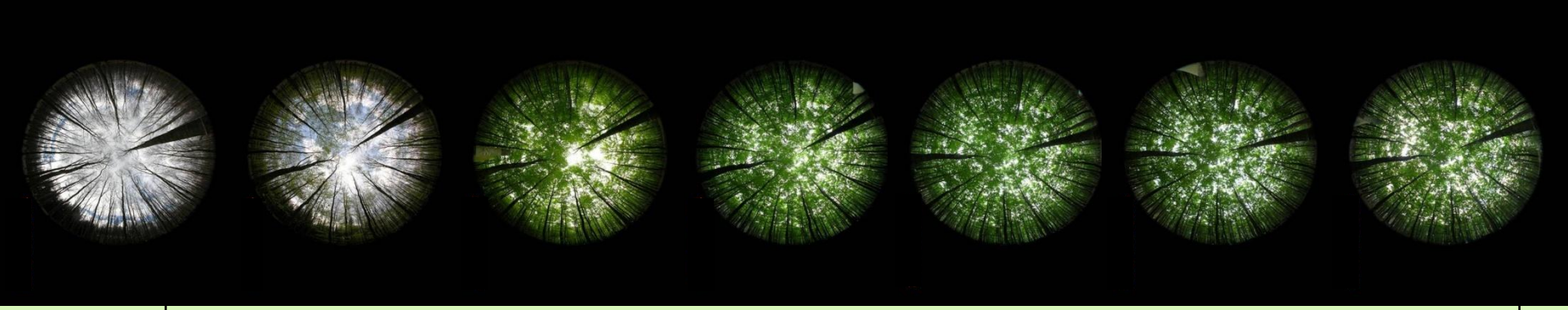


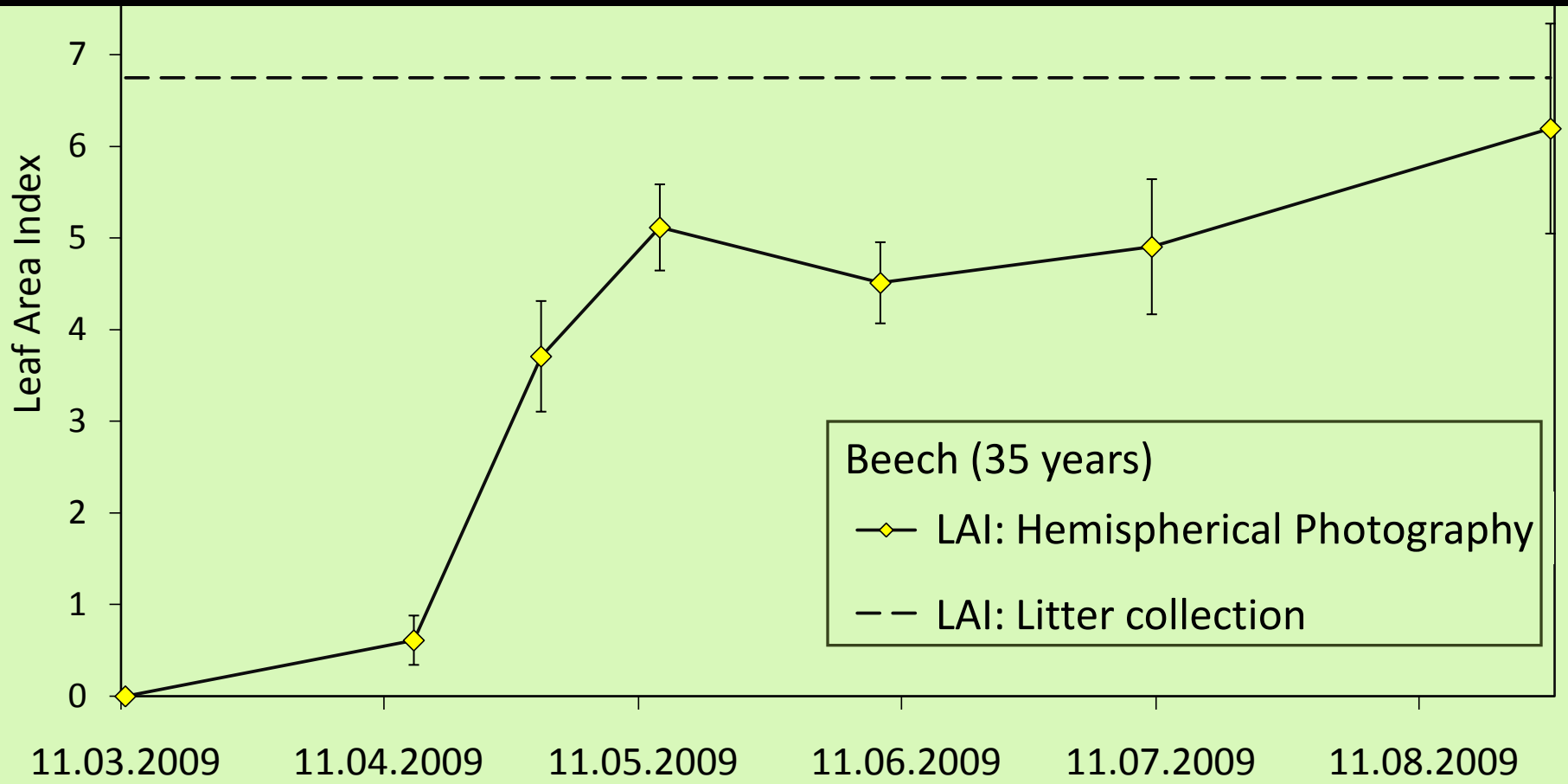



Methods

- 20 measurement-points per plot (30 x 40m)
- 10m distance between points
- 12 litter traps (3m²) inside the grid
- Photos taken several times at each plot (Intra-annual variation)

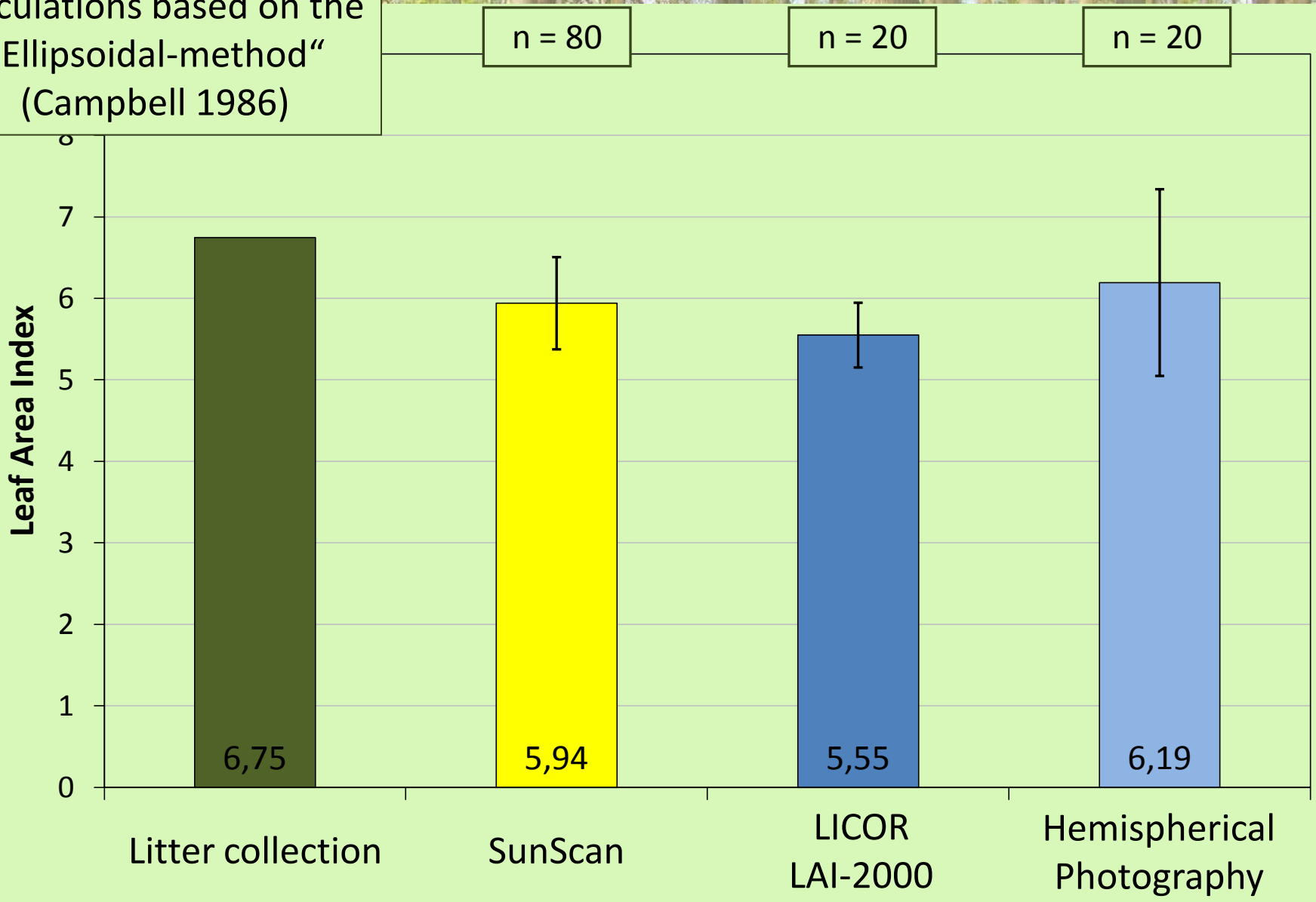





Leaf Area Index
0
1
2
3
4
5
6
7
11.03.2009
11.04.2009
11.05.2009
11.06.2009
11.07.2009
11.08.2009
Beech (35 years)
LAI: Hemispherical Photography
LAI: Litter collection

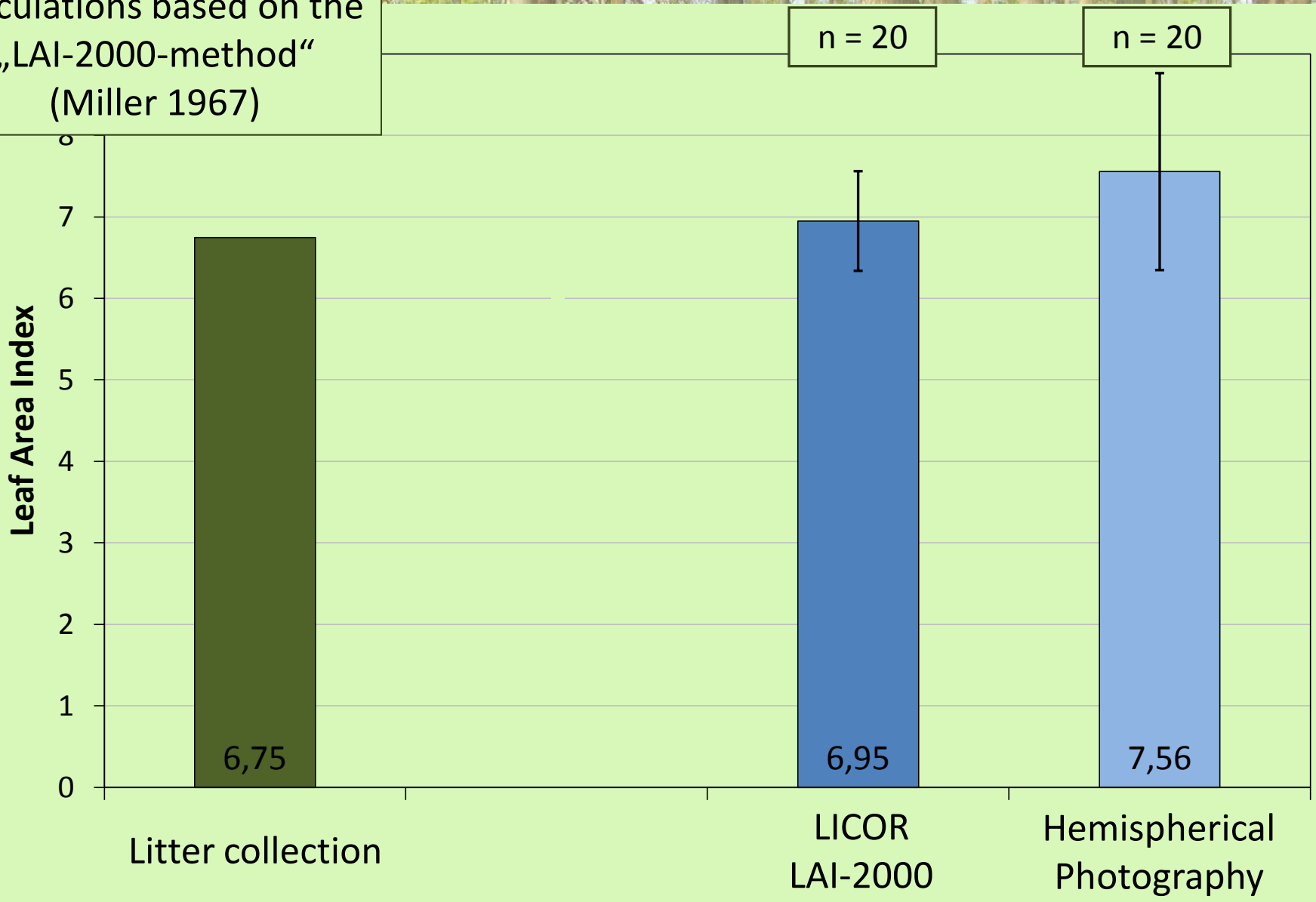
Beech (35 years)

Calculations based on the „Ellipsoidal-method“ (Campbell 1986)



Beech (35 years)

Calculations based on the „LAI-2000-method“ (Miller 1967)



Results: Correlation between methods

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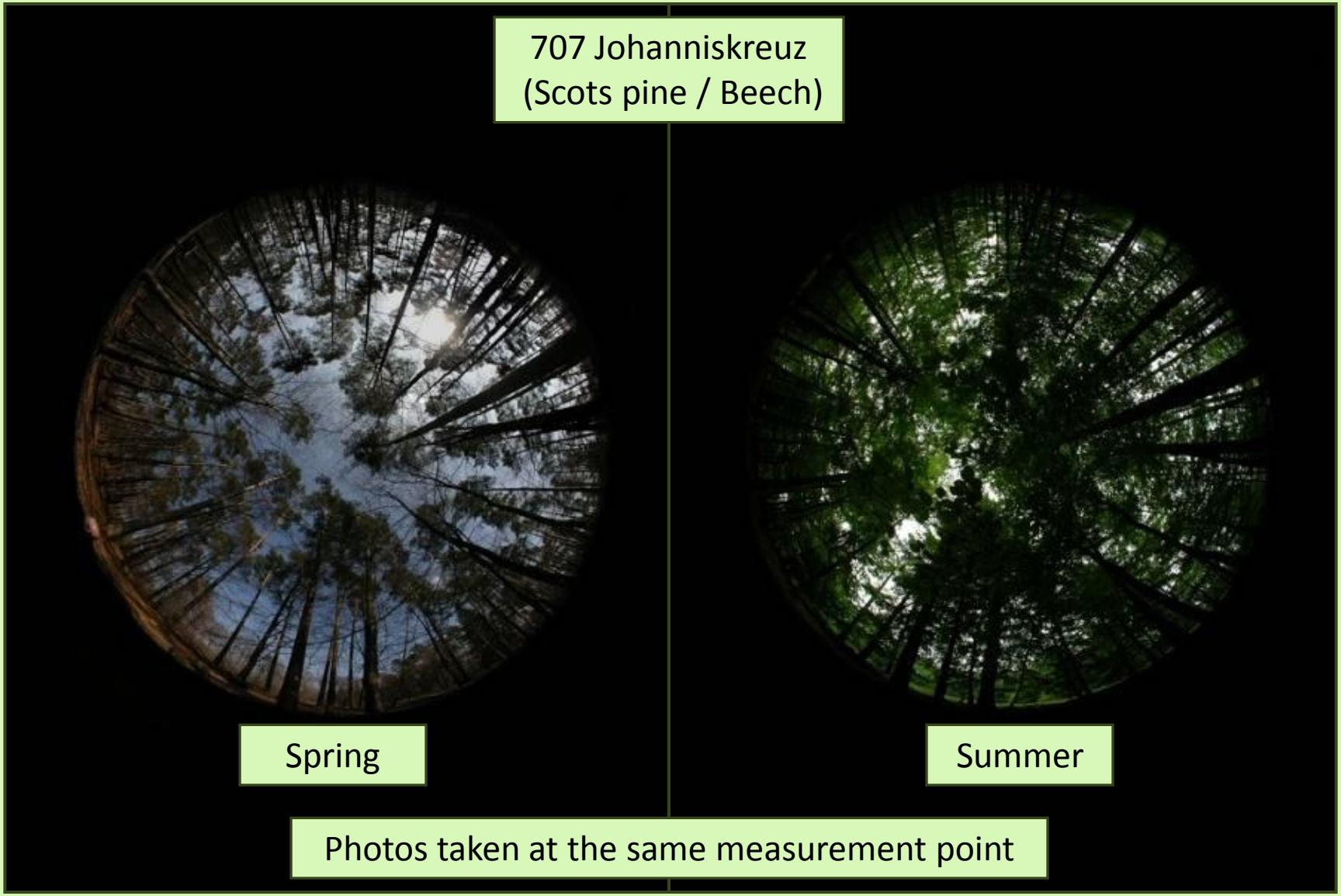
Problem: Mixed stands



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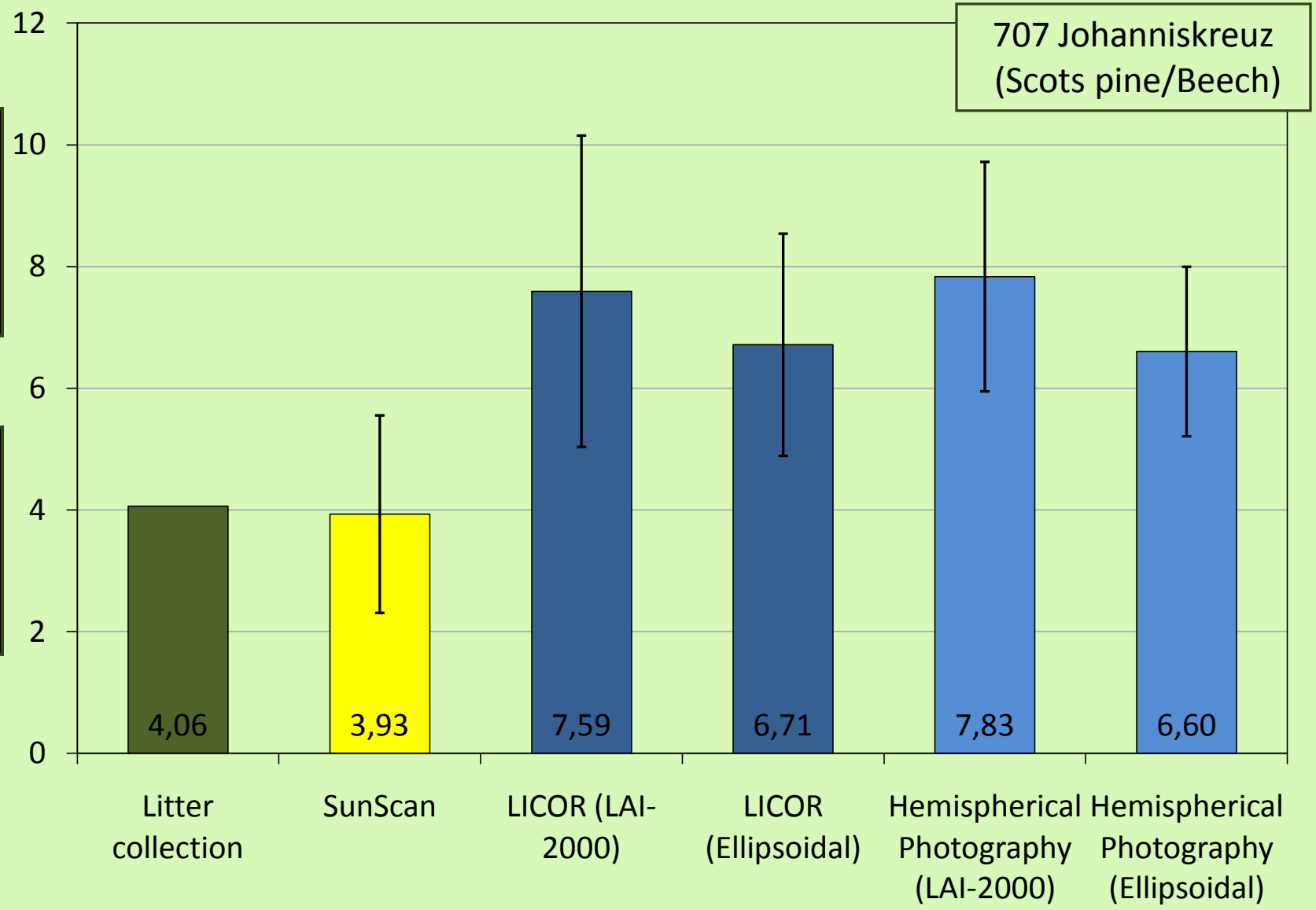


Conclusion and Recommendation

- Litter fall collection is the most reliable method for broadleaf species

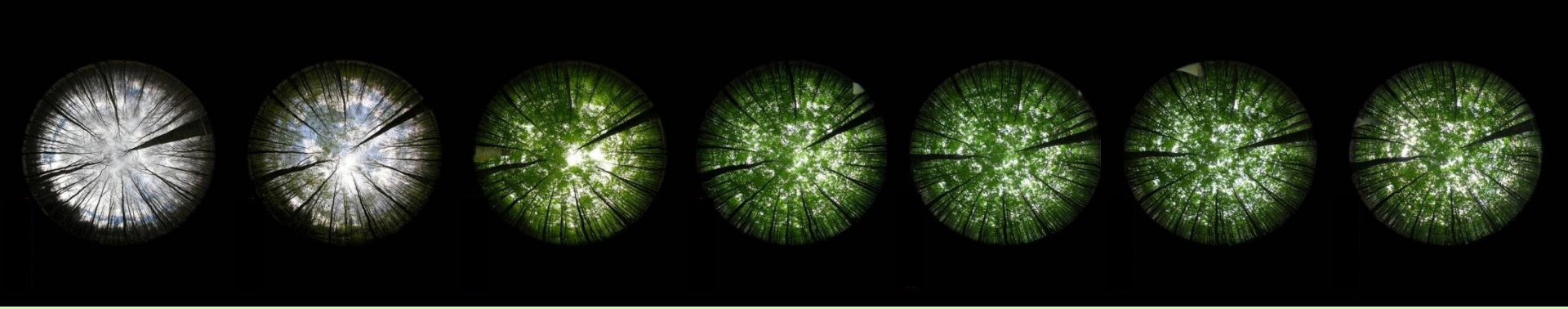
- Results of different calculation methods vary more than results of different dates calculated by the same calculation method

  - ➢ For good comparability only one calculation method should be used (=> Campbell 1986)

- Hemispherical Photography is a low priced and flexible method

  - ➢ For Gapfraction analysis a plot of 30x40m with partially overlapping photos (10m distance) is recommended

- SunScan shows good results for mixed stands



Thank you for your attention

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