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# A Rapid Method for Monitoring Vegetation

## Case study on dune communities of beaches to the southeast of Foce d'Ombrone, Maremma Regional Park, Tuscany, Italy

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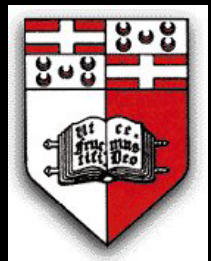


## Context:

Previous longitudinal surveys of vegetation were considered to be characterised by subjectivity and unnecessarily high precision in determination of point abundance

## Aims:

Development of a rapid, replicable method that is simple to apply to large areas in the field and that would give results that are straightforward to interpret

## Application & Testing:

Surveys of dune vegetation colonising beaches to the southeast of Foce D'Ombrone

# Techniques for Sampling Vegetation

- Line-intercept transects
- Belt transects using quadrats ($1m^2$)
- Pseudo-random quadrat throws ($1m^2$)

# Determination of Abundance in the Field

## Counting Individual Plants

**Sources of Error:**

- What is an “individual plant”?
  - Individual plants sometimes difficult to distinguish
- Labour-intensive
- Subjective
- Not always replicable

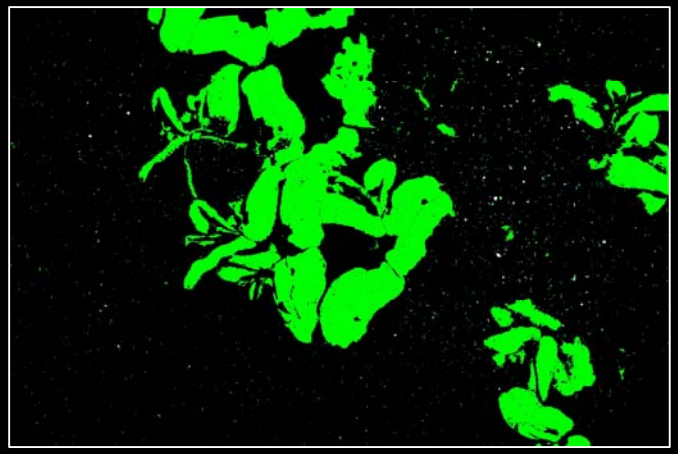
# Determination of Abundance in the Field

## Estimating coverage by inspection


**Sources of Error:**

- Probably not replicable by independent observers
- Coverage of visually-prominent plants tends to be overestimated
- Coverage of erect plants tends to be underestimated
- Coverage of sprawling plants tends to be overestimated

# Determination of Abundance through Image Analysis



- Photograph ***each*** quadrat
- Manipulate ***each*** image to emphasise vegetation pixels
- Calculate area occupied by vegetation pixels
- Much more accurate than visual inspection but very labour-intensive

# Properties of results obtained using such methods

- Very high level of detail on a very small scale
- Dependent on observer's experience and bias
- Only a very small fraction of the habitat is sampled
- Patterns of distribution perpendicular to the transect axis would be difficult to detect since the sampled area is comparable to patch size and small relative to mean distance between patches for most species
- Population/metapopulation structure difficult to detect

# Requirements of proposed method:

- Rapid enough to apply to large tracts of habitat
- Objective, and therefore replicable
- Should give clear indications of spatial and temporal change in vegetation composition
- Incrementally adjustable between changing requirements for precision and rapidity

# Proposed Method

- Area of study divided into permanent plots of equal area. Each plot is divided into at least four subplots
- Plant abundance quantified by recording presence/absence in each plot or subplot
- Subdivision of plots or subplots may be adjusted towards required levels of precision

# Recording results

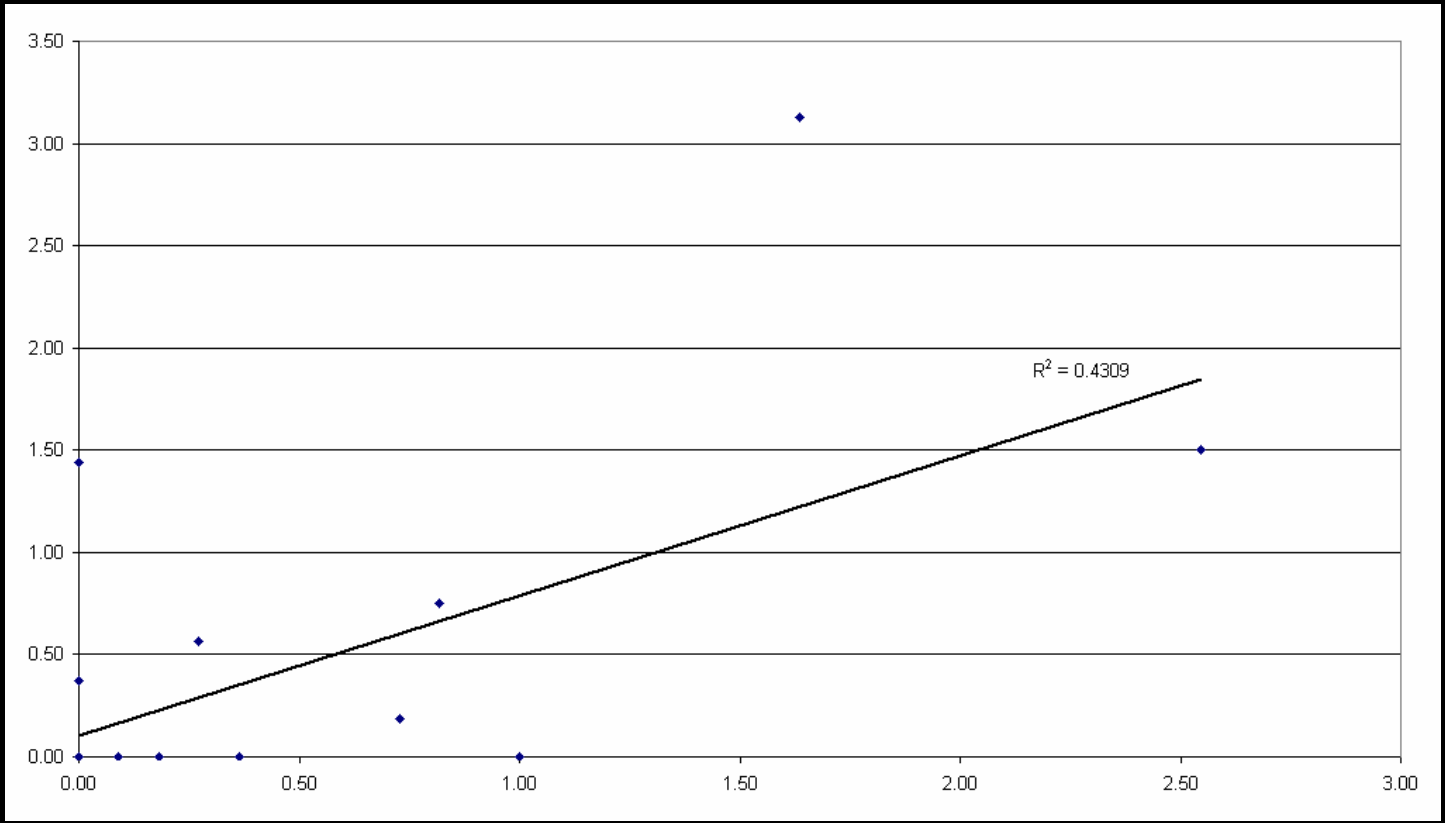
*Euphorbia peplis* 4/4

*Euphorbia peplis* 14/16

# Data Matrix for single transect

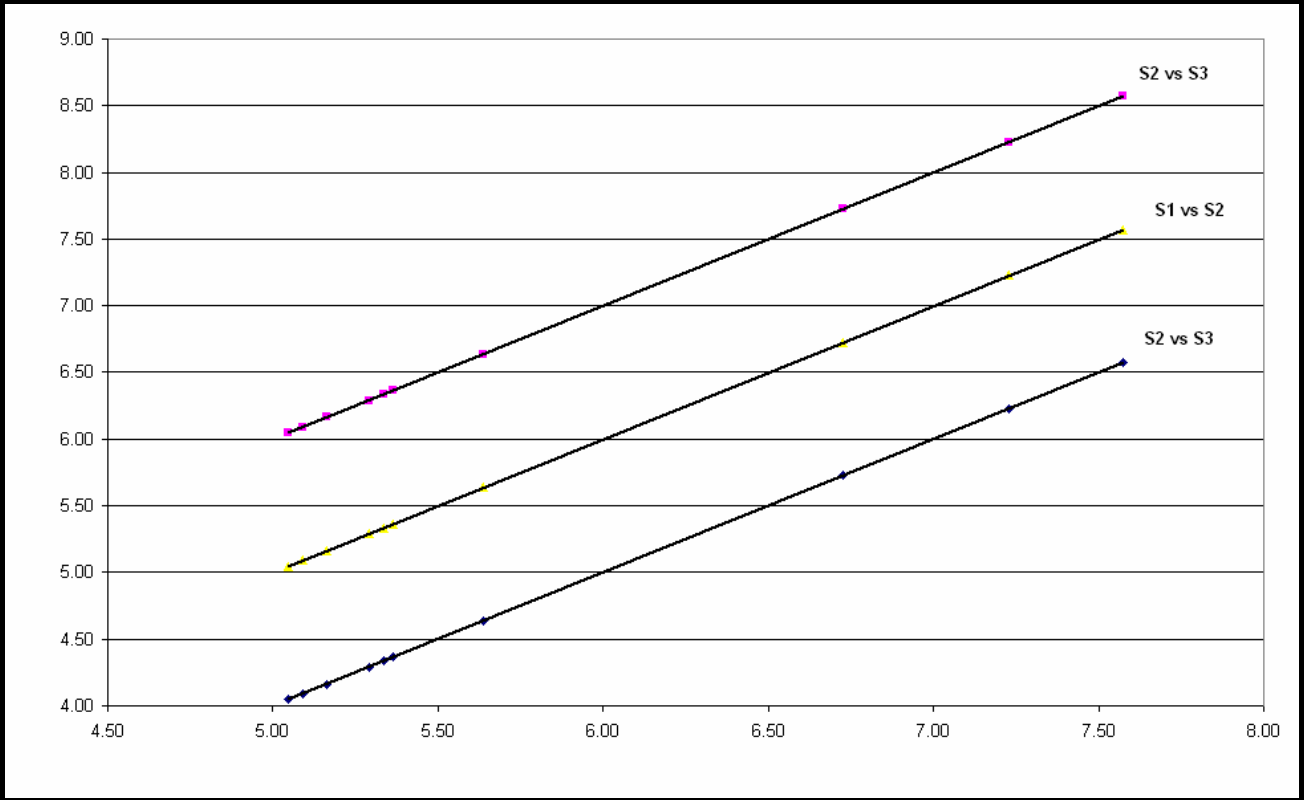
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Euphorbia paralias | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| Ammophila arenaria | 3 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulpia fasciculata | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pseudorlaya pumila | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salsola kali | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Anthemis maritima | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Juniperus macrocarpa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Helichrysum italicum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Silene colorata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ononis variegata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pinus pinaster | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Xanthium | 0 | 3 | 0 | 0 | 3 | 3 | 6 | 8 | 0 | 3 | 6 | 6 | 0 | 0 | 0 | 0 |
| Parapholis filiformis | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 10 | 10 | 10 | 10 | 8 | 8 | 3 | 8 |
| Cutandia maritima | 0 | 0 | 0 | 0 | 3 | 3 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sporobolus | 8 | 0 | 3 | 3 | 3 | 3 | 6 | 3 | 0 | 0 | 3 | 3 | 6 | 8 | 10 | 10 |
| Elytrigia juncea | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Inula crithmoides | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 6 | 10 | 10 | 10 | 8 |
| Limonium etruscum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 8 | 10 | 10 | 8 | 10 | 10 | 10 |
| Planrtago coronopus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Schoenus nigricans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 8 | 8 | 10 | 0 | 6 | 0 | 0 |
| Juncus acutus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 | 6 |
| Carex extensa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 |
| Phleum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Malcolmia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Quercus sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Euphorbia peplis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Presentation of data from successive sessions




Data from Session 1 and Session 2 are plotted on the x-axis and y-axis respectively, where each point represents a single species. The slope of the line is an indication of the changes in vegetation between the two sessions

# Behaviour of comparison line in successive monitoring sessions




S1 vs S2: Change between Session 1 and Session 2

S2 vs S3: Uniform increase in abundance in Session 3

S2 vs S3: Uniform decrease in abundance in Session 3

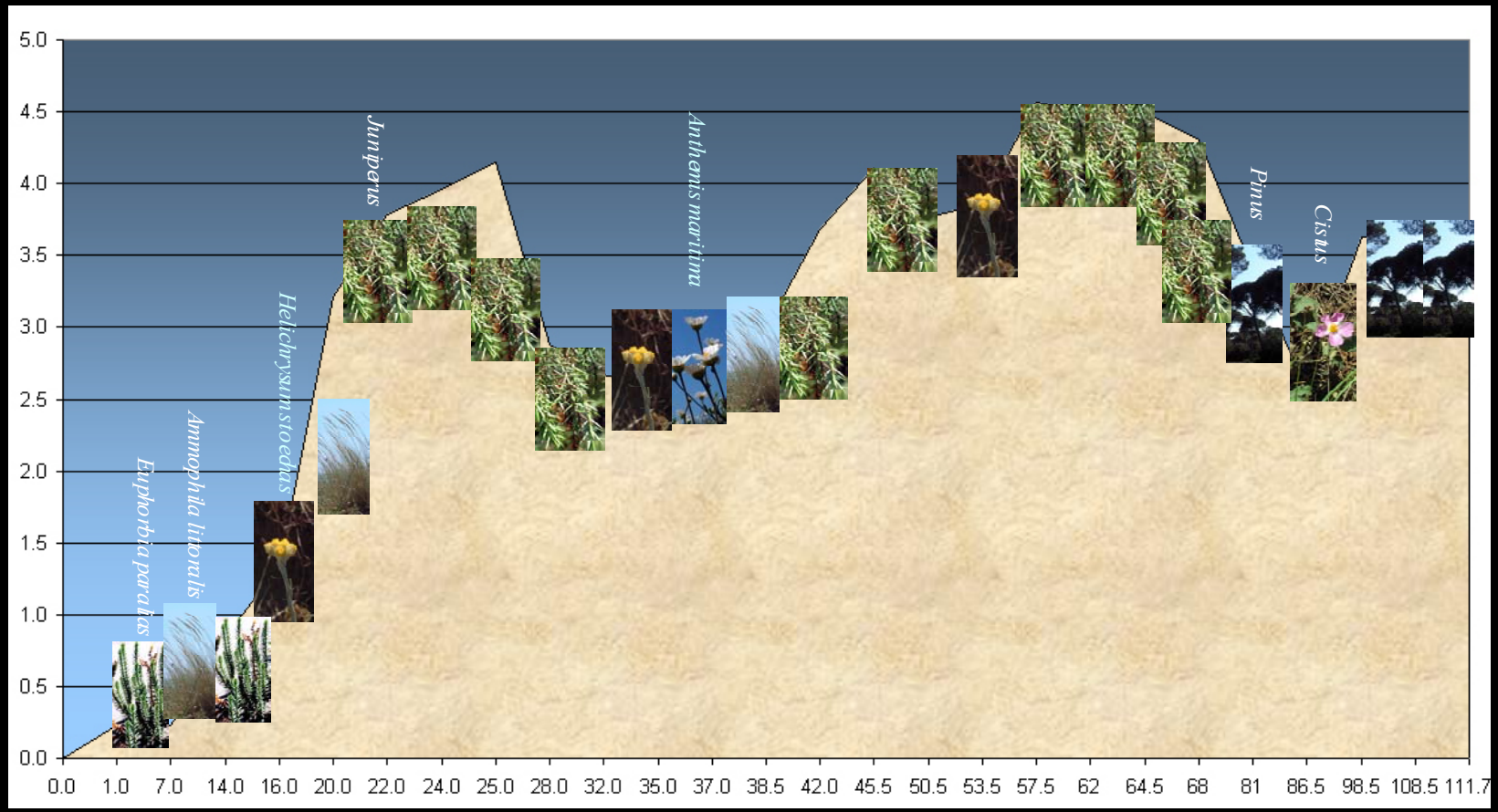
# Implementation

- Field testing was carried out at Ghallis (Malta) in 2004 and 2005 (S.Lanfranco). Significant agreement between the proposed method and our previous labour-intensive methods was achieved
- The proposed method was again tested in July 2005 at the Maremma study sites that had already been investigated in May 2003


# Area of Study

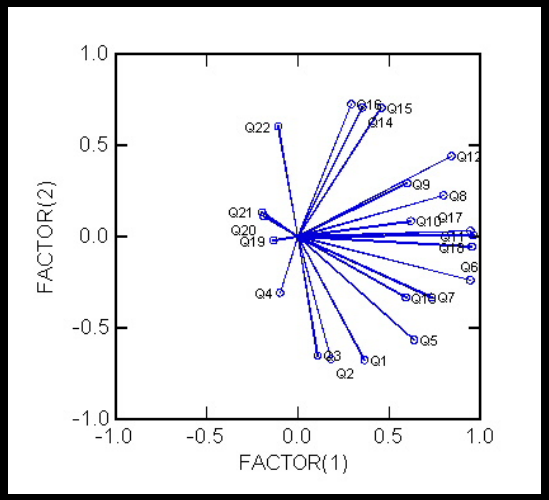

Vegetation was sampled along transects at the indicated points during May 2003 and July 2005

# Vegetation profile at Stazione 3000m in 2003

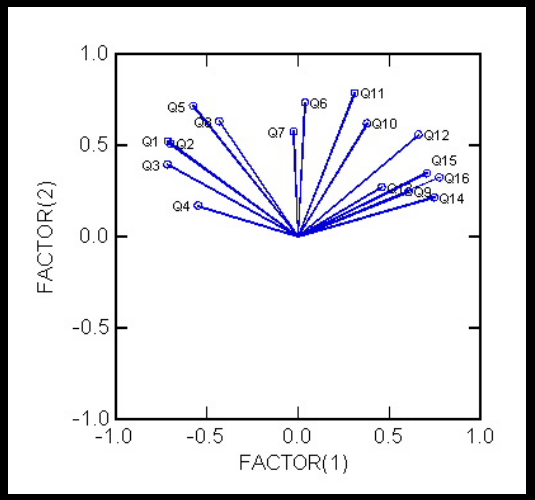



From: Cassar LF, Lanfranco S, Camilleri A & Lanfranco E (2003). Sediment dynamics & coastal dune development: observations on the geomorphology & vegetation of sand dune systems around Collelungo

# Comparability of results
# Stazione 3000 metri



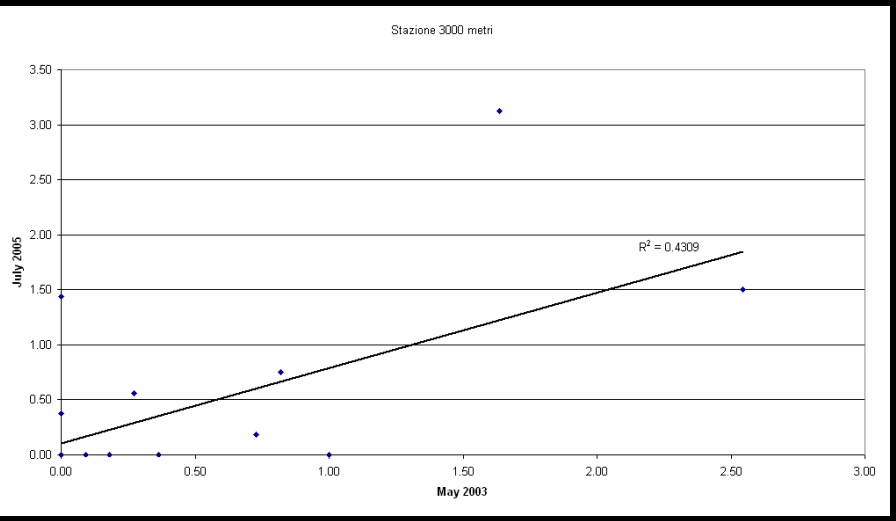

July 2005

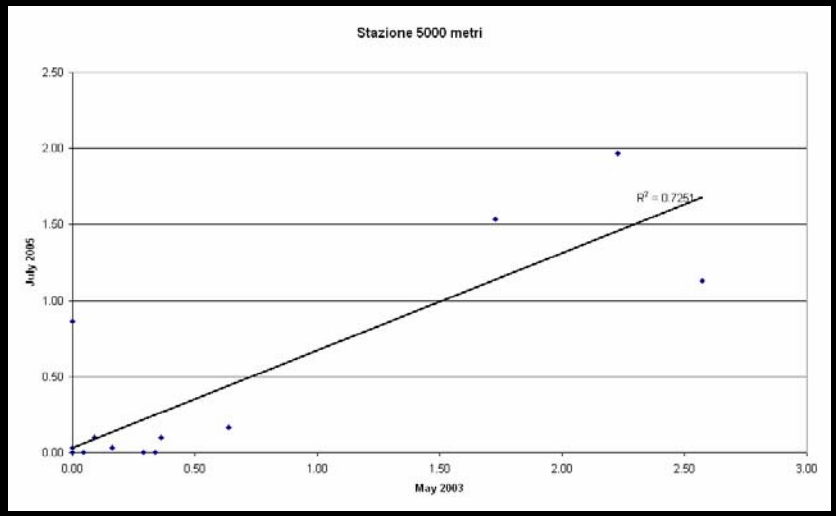


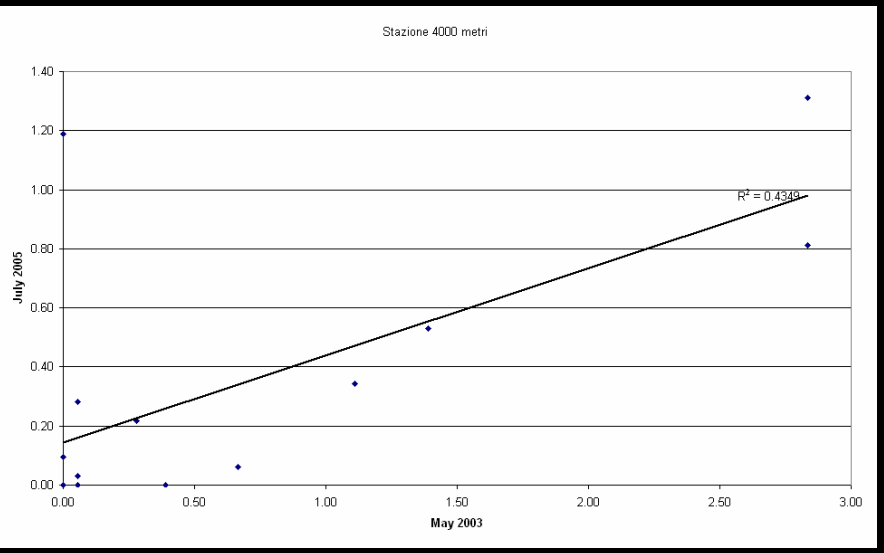

May 2003

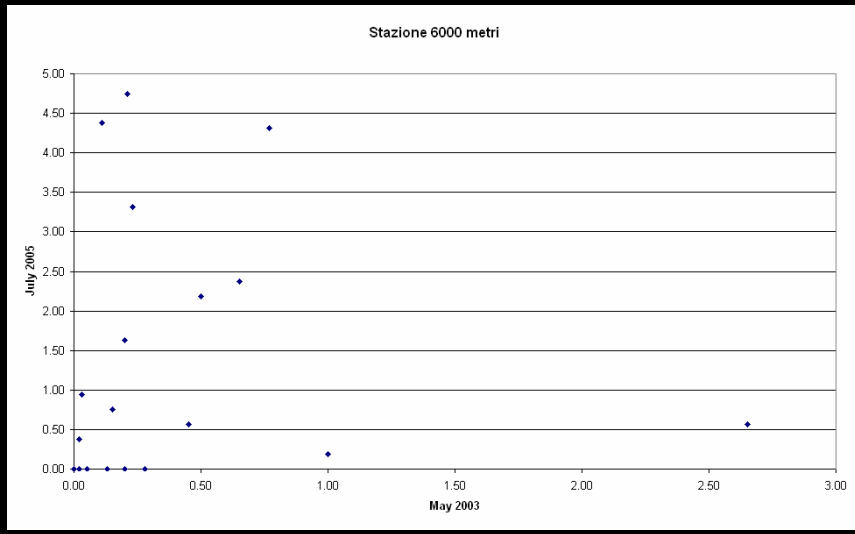
General trends seem to be preserved

# Summarised Results



# Summarised Results

| Station | n | r | R squared | P |
|---|---|---|---|---|
| 3000m | 18 | 0.6564 | 0.4308 | 0.0031 |
| 4000m | 14 | 0.6571 | 0.4318 | 0.0107 |
| 5000m | 15 | 0.8512 | 0.7245 | < 0.0001 |
| 6000m | 19 | 1.69E-05 | 2.86E-10 | > 0.9999 |
| 6000m without outlier | 18 | 0.2363 | 0.05585 | 0.3451 |

- Correspondence between coverage values obtained in 2003 and in 2005 appears generally consistent
- This was independently confirmed by comparison of vegetation from several hundred photographs taken in 2003 and in 2005

# Conclusions

- Sampling in July 2005 was completed over a much shorter timeframe (less than 50%) than in 2003
- Comparability of results suggests that the proposed rapid method can be used instead of the previous procedures
- This would in turn permit larger areas to be surveyed, giving a much more representative picture than a detailed micro-scale study
- Translates into higher output per unit effort and lower cost per unit output permitting more frequent monitoring of the vegetation of the area

# Acknowledgements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THANK YOU!