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### Study and Monitoring of Itinerant Tourism along the Francigena Route, by Camera Trapping System

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#### ABSTRACT

Tourism along the Via Francigena is a growing phenomenon. It is important to develop a direct survey of path's users (pilgrims, tourists travel, day-trippers, etc.) able to define user's profiles, phenomenon extent, and its evolution over time. This in order to develop possible actions to promote the socio-economic impact on rural areas concerned. With this research, we propose the creation of a monitoring network based on camera trapping system to estimate the number of tourists in a simple and expeditious way. Recently, the camera trapping, as well as the faunal field, is finding wide use even in population surveys. An innovative application field is the one in the tourist sector, becoming the basis of statistical and planning analysis. To carry out a survey of the pilgrims/tourists, we applied this type of sampling method. It is an interesting method since it allows to obtain data about type and number of users. The application of camera trapping along the Francigena allows to obtain several information about users profiles, such as sex, age, average lengths of pilgrimages, type of journey (by foot, by horseback or by bike), in a continuous time period distributed in the tourist months of the 2014.

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**Keywords:** Landscape; Cultural Heritage; Rural Areas; Sustainable Tourism; Pilgrimage route

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## Introduction

Tourism along the Via Francigena is a growing phenomenon. In addition to the religious motivation, recently other motivations drive people to make a journey along an historical route. Tourism is definitely one of these reasons, which often does not interest all the path, but small parts of it.

For that reason, becomes important to develop a direct survey of the path users (pilgrims, tourists, day trippers, etc.) able to define the user's profiles, the extent of the phenomenon, and its evolution over time. This is to carry out a study of the tourism phenomenon linked to the Via Francigena flow and possible actions to be taken to foster and improve services along that path.

In addition, there is a growing interest in a pilgrimage route that could represent a tourism product for different fruition target: on foot, on horseback, by bicycle. It is therefore essential to develop surveys aimed to flows estimate on the way, given the enormous historical value it has. The Via Francigena not only as a pilgrimage journey, but as a rediscovery journey of territories and cultural traditions.

The study aims to investigate the tourist phenomenon related to the pilgrimage along the Via Francigena in Tuscany. In particular, it tried to define a "User" profile of the Via Francigena, and a numerical estimate of passersby along the Tuscan section.

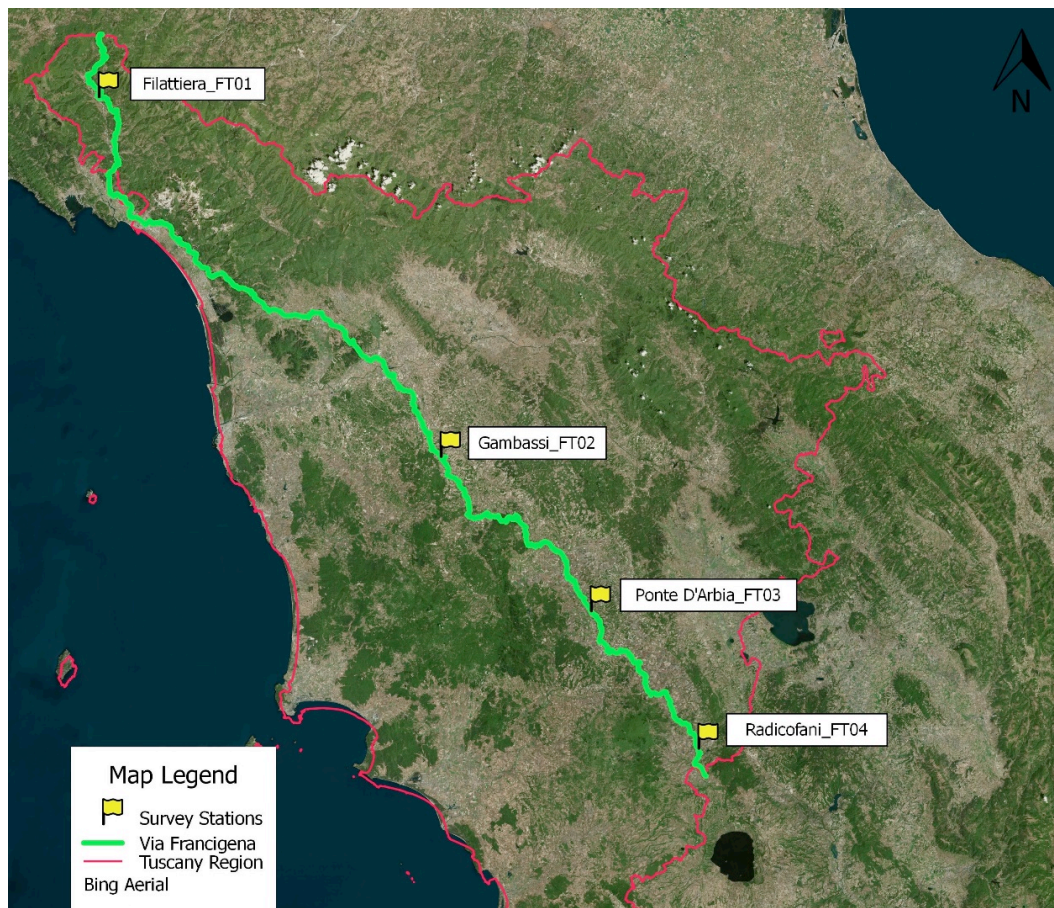
## 1. Materials and Methods

The survey involved the Tuscan Via Francigena route (about 400 km) by installing four survey stations for the passersby survey (photo capture and questionnaires), active for a period of 15 months (February 2015 - May 2016). The survey stations are installed in points that ensure as much as possible the sample of Francigena users only, in order to realize a representative sampling.

For each survey station was assigned a code composed of abbreviation FT and serial number identifying of camera trap

The four stations are distributed as follows:

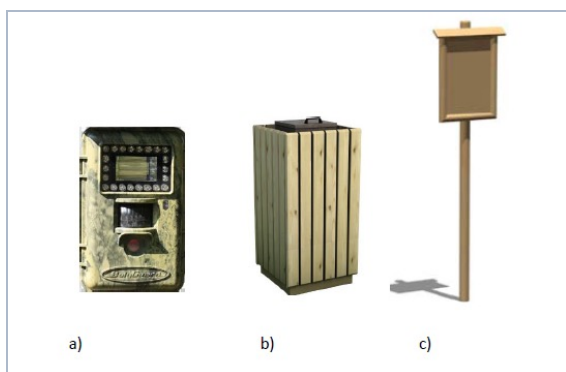
- FT01: Filattiera (MS), in the first part of the Francigena between Cisa and Aulla (north of Tuscany) (Fig.3);
- FT02: Gambassi (FI), in the section between San Miniato and Siena (centre of Tuscany) (Fig.4);
- FT03: Ponte d'Arbia (SI), in the section between Siena and San Quirico D'Orcia (centre of Tuscany) (Fig.5);
- FT04: Radicofani (SI), in concluding part of Francigena (south Tuscany) (Fig.6).



**Figure 1:** Survey stations location

The study involved the construction of small rest areas, composed as follows:

- 1) n. 1 waste basket, containing the camera trap;
- 2) n. 1 notice board, to encourage the stop of the pilgrim / tourist as well as to facilitate the photographic capture. It is composed of a forex panel showing information about the project (in its upper part); in the lower part we have realized two special boxes containing questionnaires to fill out in anonymous form.



**Figure: 2** Material and equipment used: a) camera traps, b) waste basket, height 95 cm, depth 50 X 50 cm, c) outdoor boards, post  $\varnothing$  8cm, height 250 cm, usable panel 40 x 60 cm.



**Figure 3:** Camera Trap FT01 – Filattiera



**Figure 4:** Camera Trap FT02 – Gambassi





**Figure 5:** Camera Trap FT03 - Ponte D'Arbia



**Figure 6:** Camera Trap FT04 - Radicofani

### *1.1. Data Collection*

For the monitoring, two survey methodologies have been adopted:

- An independent type, by the survey with photo capture.
- A voluntary type, by preparing questionnaires to fill out. This technique is related to the willingness of people to complete the questionnaire.

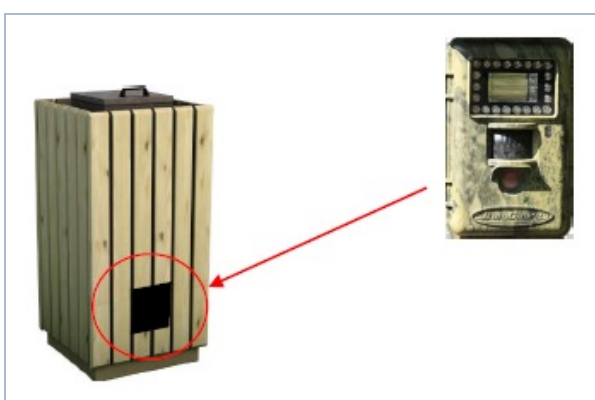
### *1.2. Photo Capture Survey*

The photo capture technique allows the survey of all the passages by the triggering of a sensor. It is therefore an independent methodology by the users will. The camera will be triggered by any movement in the interest area (ROI), monitored by a high-sensitivity passive infrared movement sensor (PIR), and will take pictures of high quality (up to 8 mpx) or video clips. The camera traps provide important temporal information such as time and date of each captured image. All data (photos and videos) are stored in the internal memory (SD card), which allows to store data for

long-term surveys. In addition, the batteries provide power for the duration of the study (even more than three months).

The camera trapping technique is widely spread in the faunistic field, for the monitoring of wild animal species, especially useful for the elusive species, for which no census would be possible by sight. This technique allows to obtain information about the presence of a species, as well as the phenotypic characteristics of the individuals, their behavior and their habits (seasonal and daily). The study thus makes use of a new and experimental technique in monitoring flows along a path.

Sampling with photo capture presented some difficulties related to the protection of the detected people privacy. For this reasons, we have installed the cameras inside the lower part of the basket waste (Fig. 7) so that the acquisition of the image / video does not concern the people's faces.



**Figure 7:** Camera trap installing inside the waste basket

As a first step, were employed 6V 5Ah rechargeable batteries for the power supply of the camera traps. however, the first applications have shown a low autonomy of these batteries, especially for video mode, with the consequent loss of data. To overcome this problem have been applied 6V 12 Ah battery, improving performance of three survey stations (FT01, FT02, FT03). For Radicofani station (FT04) it was adopted a solar panel solution to increase the autonomy.

#### QUESTIONNAIRE SURVEY

By the survey station, the pilgrim could also find a mini-questionnaire, consisting of few questions in Italian and English version. This will assist us in defining the characteristics of the sampled subjects, regarded the inability to photograph the people faces. In addition, the questionnaire will allow cross-checked with photo capture method. Furthermore, will be checked the pilgrim's willingness to cooperate with such investigation (completed questionnaires number / total transits). Fig. 8 shows the questionnaire model:


 <p style="text-align: center;"><b>Questionario / Questionnaire</b>  <b>Studio e monitoraggio del turismo itinerante legato al percorso della via Francigena Toscana</b>  <i>Study and monitoring of itinerant tourism related to the Via Francigena route in Tuscany</i></p>							
Sesso/Sex	<input type="checkbox"/> M <input type="checkbox"/> F	Età/Age		Data/Date		Orn/Time	
Nazionalità Nationality	Mezzo utilizzato How have you travelled?		<input type="checkbox"/> A piedi/On foot <input type="checkbox"/> Bici/By bicycle <input type="checkbox"/> A cavallo/On horseback <input type="checkbox"/> Altro (specificare)/Other (specify):				
Tragitto totale percorso della Francigena Total covered route of Francigena		Partenza (località/città/provincia): Departure (place/village/city): Arrivo (località/città/provincia): Arrival (place/village/city):					
Data inizio viaggio Start date of trip			Data fine viaggio End date of trip				
Hai viaggiato Have you travelled		<input type="checkbox"/> Da solo By yourself	<input type="checkbox"/> In coppia In couple	<input type="checkbox"/> In gruppo In group N*.....			
Quale motivo ti ha spinto a percorrere la Via Francigena? Purpose of the trip		<input type="checkbox"/> Religioso <input type="checkbox"/> Culturale <input type="checkbox"/> Naturalistico – ambientale <input type="checkbox"/> Sportivo <input type="checkbox"/> Di ricerca personale/spirituale <input type="checkbox"/> Di studio/Formativo <input type="checkbox"/> Altro (specificare):			<input type="checkbox"/> Religious <input type="checkbox"/> Cultural <input type="checkbox"/> Environmental <input type="checkbox"/> Sport <input type="checkbox"/> Personal/ Spiritual research <input type="checkbox"/> Formative research/Study <input type="checkbox"/> Other (specify):		
Quali sono le criticità in generale incontrate lungo il tratto toscano della Via? (seguire maxime tre risposte) Which critical issues did you notice along the Tuscan path of Francigena? (choose three answers at the most)		<input type="checkbox"/> Alloggio <input type="checkbox"/> Punti di tappa e di ristoro <input type="checkbox"/> Segnaletica <input type="checkbox"/> Punti informativi <input type="checkbox"/> Manutenzione percorso <input type="checkbox"/> Sicurezza percorso <input type="checkbox"/> Altro (specificare):			<input type="checkbox"/> Accommodation <input type="checkbox"/> Stop off <input type="checkbox"/> Signposting <input type="checkbox"/> Information points <input type="checkbox"/> Path maintenance <input type="checkbox"/> Path security <input type="checkbox"/> Other (specify):		
Come sei venuto a conoscenza della Via Francigena? How did you learn about the Via Francigena?		<input type="checkbox"/> Sito web (specificare nome) / Other web site (specify): ..... <input type="checkbox"/> Social network o blog (specificare) / Social network or blog (specify): ..... <input type="checkbox"/> Media: tv, stampa (specificare nome) / Media: television, press (specify): ..... <input type="checkbox"/> In seguito ad altri pellegrinaggi. Quali? Following other pilgrimages. Which one? ..... <input type="checkbox"/> Amici, conoscenti / Friends or family <input type="checkbox"/> Università o scuola / University or school <input type="checkbox"/> Altro (specificare) / Other (specify): .....					
Durante il percorso, quali strumenti di guida hai utilizzato? Which guiding tool did you use along the way?		<input type="checkbox"/> Percorso scaricabile dal sito web (specificare il sito): The path that I downloaded from the web site (specify which web site): ..... <input type="checkbox"/> Guida cartacea (specificare titolo e nome autore): Paper guide (specify the title and the author): ..... <input type="checkbox"/> Mappe/Cartine (specificare): Map (specify): ..... <input type="checkbox"/> Altro (specificare): Other (specify): .....					
Note / Notes							

Figure 8: Questionnaire model

### 1.3. Data Analysis

Analysis was carried out considering data obtained from the questionnaires such as sub-sample of the larger population of camera traps, whereas the proportions between categories investigated with both methods are constants. In addition, the two combined techniques have allowed cross-check data.

Total numbers of passerby obtained by camera trap are shown in Tab.1. The data obtained through the camera trap are indicative of the real flow and affected by error, because the camera did not work in a continuous way, for technical problems. For this reason, the technique is being refined in order to mitigate the errors inherent in a sampling type never tested before to similar survey.

**Table 1:** Passerby total number in 15 months.

Locality	COD	Pilgrims recorded
FILATTIERA	FT01	756
GAMBASSI	FT02	2682
PONTE D'ARBIA	FT03	1850
RADICOFANI	FT04	1480
TOT		6768

The total numbers of questionnaires collected for each station (in the 15 months of study) are shown in Tab.2.

**Table 2:** Questionnaires total number

Locality	COD	Questionnaires filled	Pilgrims recorded
FILATTIERA	FT01	246	493
GAMBASSI	FT02	414	922
PONTE D'ARBIA	FT03	319	580
RADICOFANI	FT04	353	721
TOT		1.332	2.716

The 40% of the total captured passersby by the camera trap has filled out the questionnaire available at the survey station.



### *1.5. Database Construction*

Regarding the data obtained from camera trap, we carried out the check of all the photos and videos, recording the following information:

1. ID, unique code for each image / video
2. Date
3. Month
4. Time
5. Total number of persons captured in the image / video
6. Gender
7. Fruition target (on foot, by bike, on horseback)

Inserting questionnaires data was carried out by an electronic file, one for each survey station, as follow:

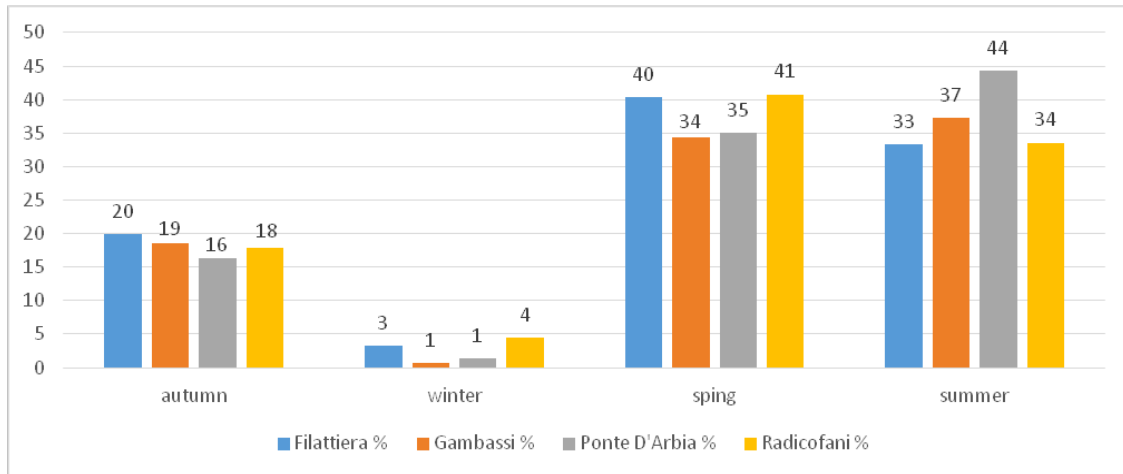
1. ID questionnaire (eg. FT01\_0001) is an alphanumeric code comprising: photo trap code and serial number identifying the questionnaire (0001, 0002, 0003 ...).
2. N° Pilgrims
3. Date
4. Month
5. Time
6. Sex
7. Age
8. Age classes
9. Nationality
10. Fruition target: on foot, on horseback, by bike
11. Departure (place/village/city)
12. Arrival (place/village/city)
13. Start date of trip
14. End date of trip
15. N° travel days
16. Travel mode (by themselves, in couple, in group)
17. N° members of the group
18. Purpose of the trip
19. Problems found along the route
20. How did they learn about the Via Francigena
21. Guiding tool

## **2. Results**

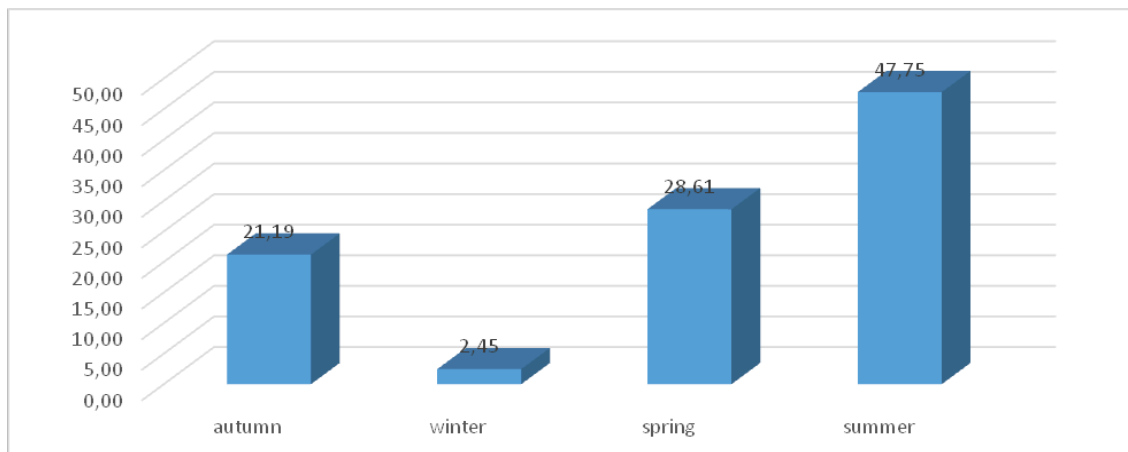
Questionnaires results were compared with those obtained through camera traps technique.

### 2.1. Pilgrims Distribution By Season

Processing of the questionnaire data shows a strong tendency to travel in the spring and summer months (Fig. 9). Anyway it also shows a presence even in autumn and winter months, which in the past was not verified. The same trend is expressed by the camera trap data (Fig. 10).

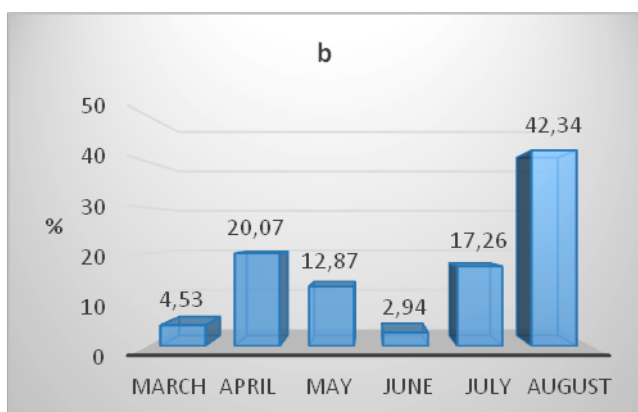
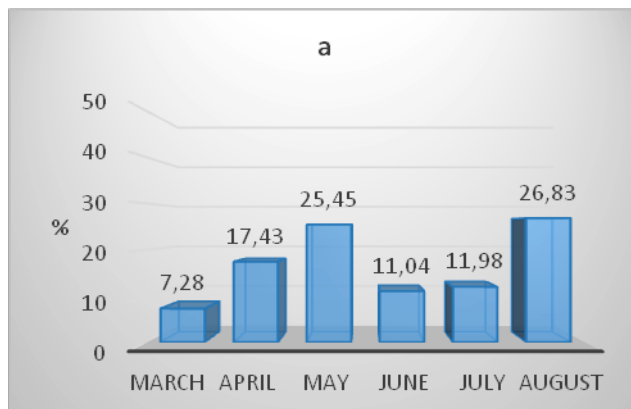


**Figure 9:** Questionnaire data of pilgrims distribution by season



**Figure 10:** Camera trap data of pilgrims distribution by season

Most frequented months in the spring and summer seasons are April, May and August (questionnaire data Fig. 11.a, camera trap data Fig. 11.b).



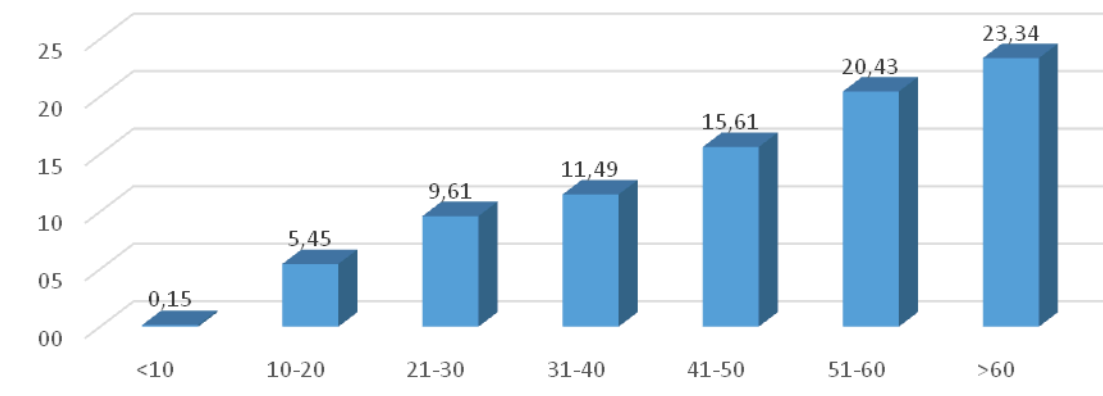
**Figure 11:** Most frequented months: a) questionnaire data; b) camera trap data.

## 2.2. Age Classes

The most represented age classes were defined through the questionnaires data, as it is not possible to define user's age from the images / videos captured. Figure 12 shows that the most frequent classes are 51-60 (20,4%) and over 60 (23,4%).

**Table 3:** Age classes percentage distribution

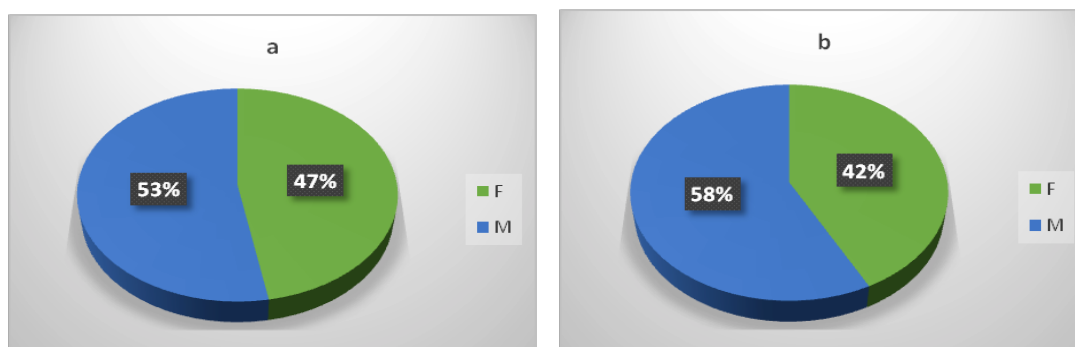
Age class	%
<10	0.1
10-20	5.4
21-30	9.6
31-40	11.5
41-50	15.6
51-60	20.4
>60	23.3



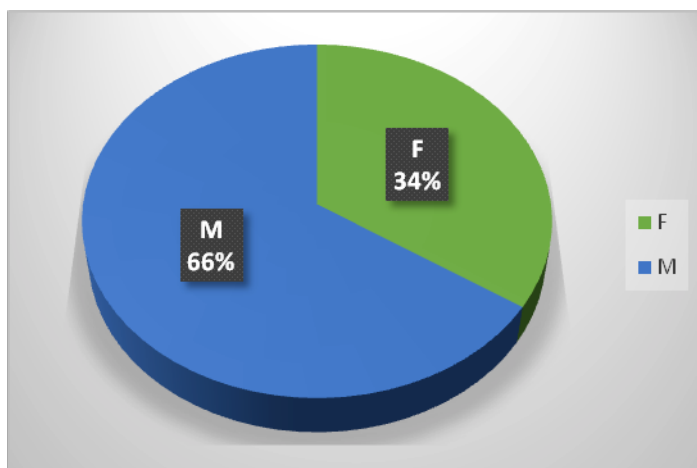
**Figure 12:** Age Classes Distribution

### 2.3. Gender Distribution

The distribution between genders shows the same trend for both questionnaires data and camera trap data (Fig. 13). In Fig. 14 are shown the percentage of males and females walking the path "alone".



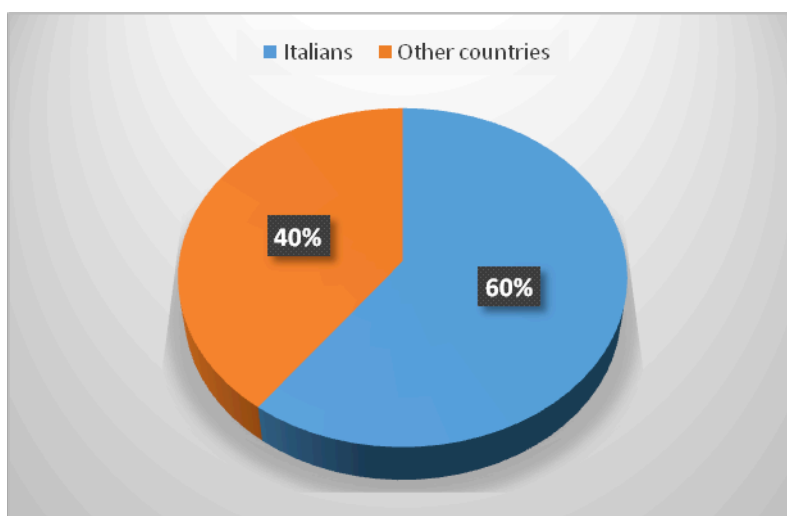
**Figure 13:** Gender Distribution: a) questionnaire data; b) camera trap data.



**Figure 14:** "Walk Alone" Distribution of Males and Females (questionnaire data)

#### 2.4. Nationalities Distribution

Analysis obtained by the four stations reports the numerical predominance of the Italians along the Tuscan section (Fig. 15)



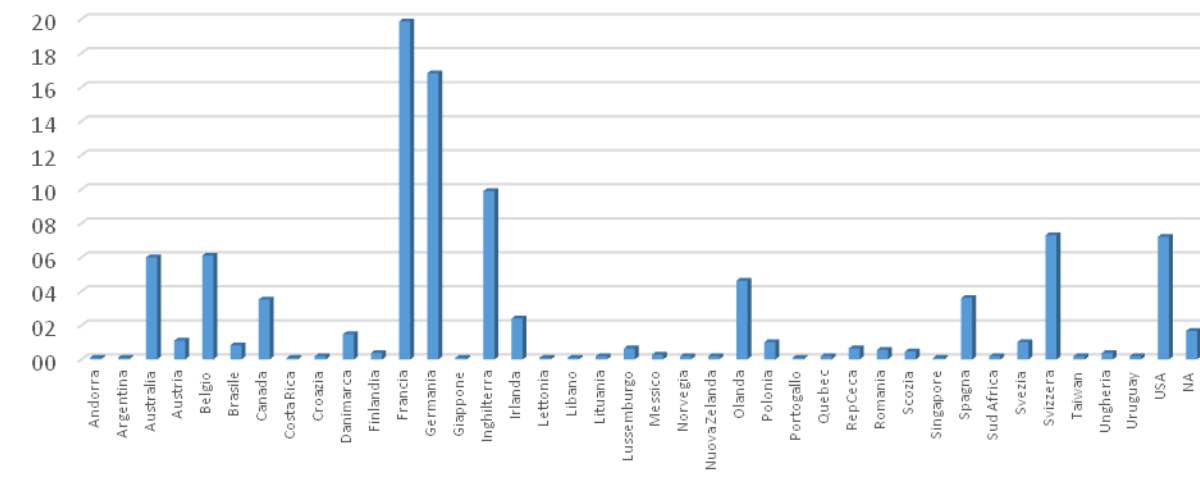
**Figure 15:** Nationality distribution

The collected nationality for all survey stations are represented by the graph below (Fig. 16), with higher percentages for France, Germany, England, Switzerland (Tab 3).



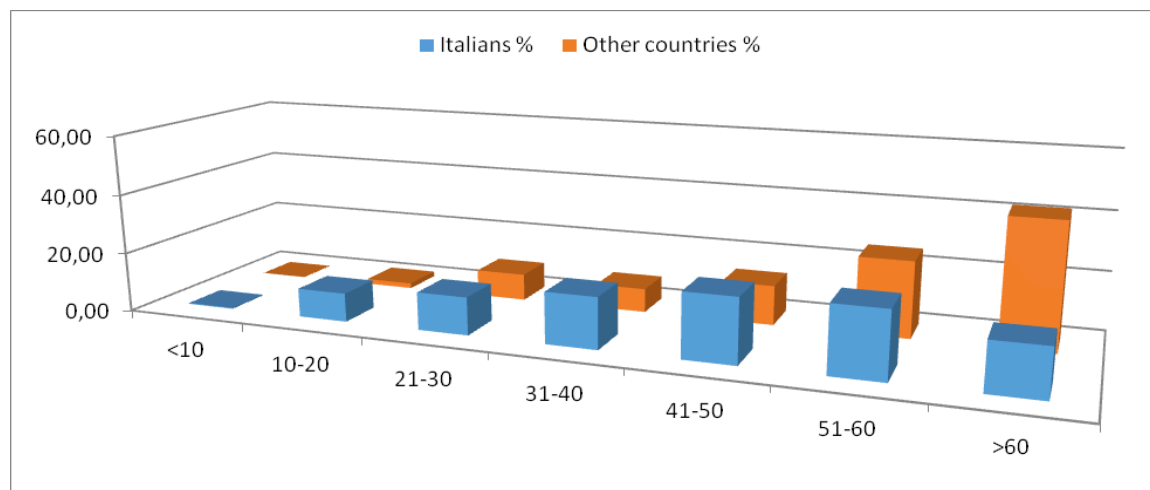
**Table 4:** Most rappedresented countries percentage

Nations	%
Francia	19.9
Germania	16.8
Inghilterra	9.9
Svizzera	7.3
Usa	7.2



**Figure 16:** Total countries number

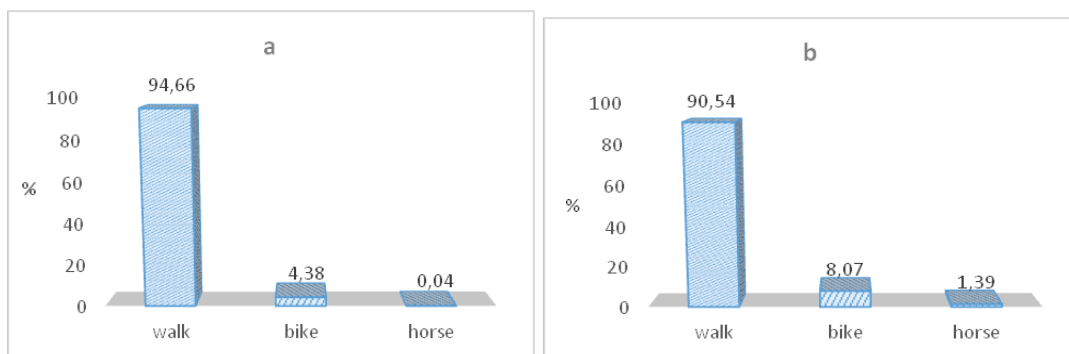
The comparison between the nationalities and age classes shows that the highest percentage of foreigners is in the over 60 class, while for Italians the most represented classes are 41-50 and 51-60 (Fig.17).



**Figure 17:** Distibution between the nationalities and age classes

## 2.5. Fruition Target

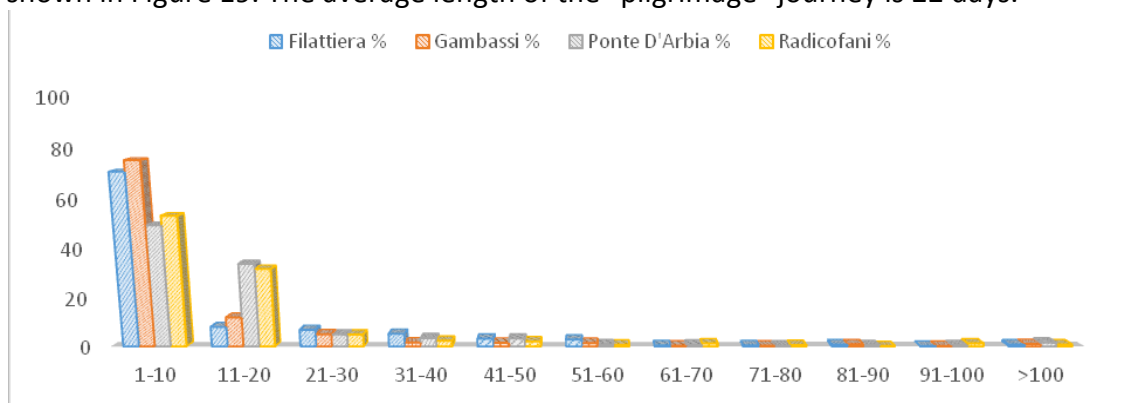
The analysis of the most represented fruition target, asking if the pilgrims were traveling by foot, by bike or on horseback, shows the "walking mode" prevalence both for questionnaires and camera trap (Fig. 18).



**Figure 18:** Fruition target: a) questionnaire data; b) camera trap data.

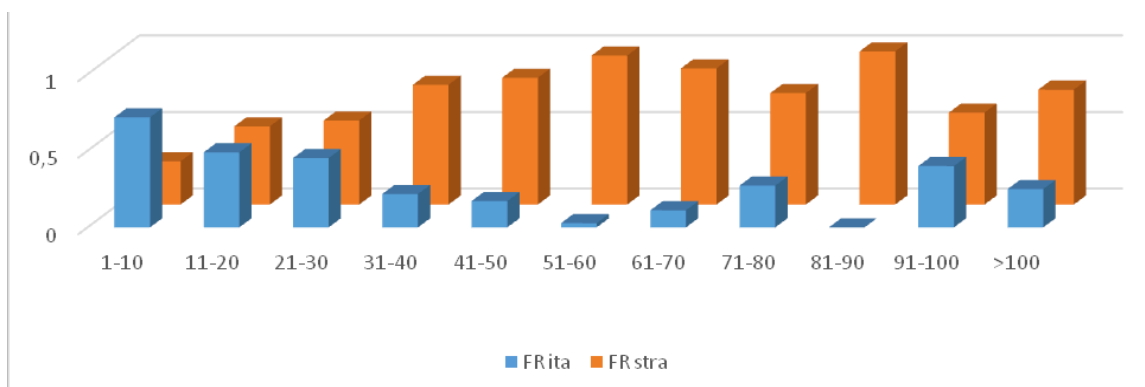
## 2.6. Length of Journey

It was also investigated the time that "pilgrims" spend along the way, defining a 10-day stay ranges. The most represented permanence class is the one from 1 to 10 days, as shown in Figure 19. The average length of the "pilgrimage" journey is 22 days.



**Figure 19:** Distribution of permanence classes

Distribution of the relative frequencies for permanence classes: the graph below (Fig.20) shows the difference between the preferences of the Italian users and the others nationalities.

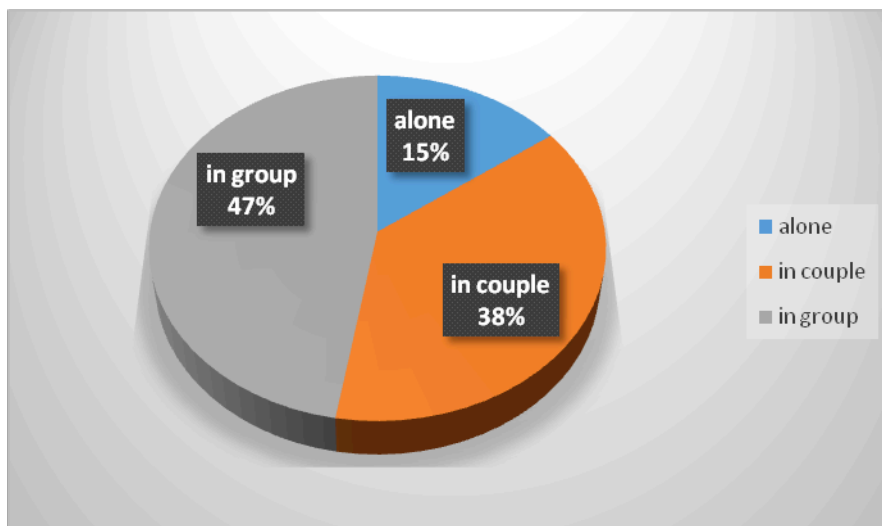


**Figure 20:** Relative frequencies for permanence classes

The 35 % those surveyed chose only the stages of Tuscany; 88% choose the stages from Lucca to Rome. 40% of total surveyed arrived to Rome.

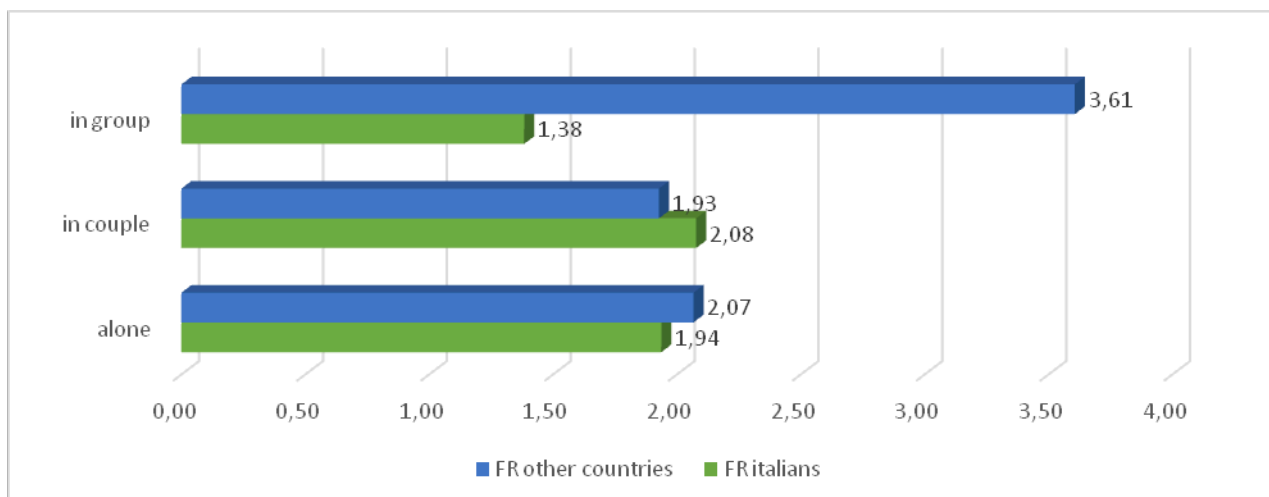
### 2.7. Travel Mode

The preferred travel mode by users is "in group" (47%), followed by the "in couple" (38%) and "alone" mode 15%. The average number of groups is 5 persons.



**Figure 21:** Travel mode preference

The graph below (Fig.22) shows the difference between the preferences of the Italian users and the others nationalities regarding the travel mode. These differences are minimal for "in couple" and "alone" mode, showing similar preferences, while differ much for "in group" mode, preferred by foreign pilgrims.



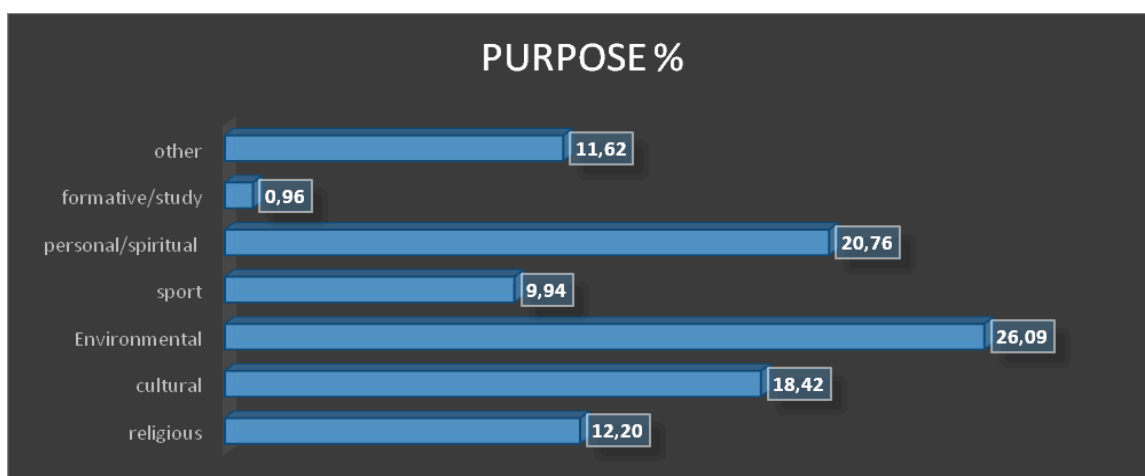
**Figure 22:** Relative frequencies for travel mode

## 2.8. Purpose Of The Trip

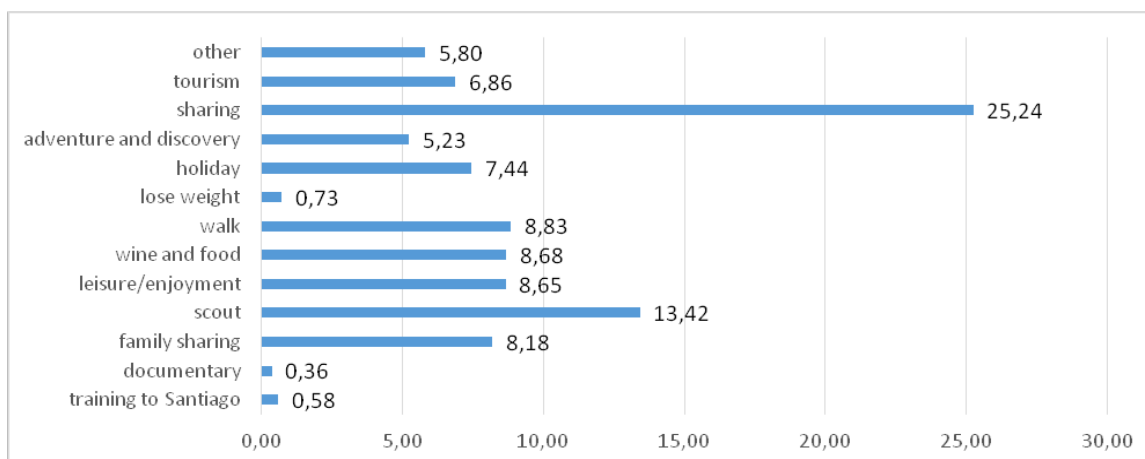
The questionnaire asked the pilgrims to indicate the reason that led them to embark on the path and critical situations found along the way. It was not asked the user to express a values scale of choices. So, in case of multiple selections, we have calculated a score to define the user's preference. That score was obtained by dividing the number of choices for the total number of options (choices number / total options).

Was asked the pilgrim to choose from the following reasons: religious, cultural, nature and the environment, sports, personal / spiritual research, study / training, others reasons.

The survey indicates that the main travel motivation is the naturalistic and environmental, with the 26 % of the votes, followed by the personal and spiritual research (20,76 %), cultural purpose with 18%, religious (12%), sportive (about 10%) and formative/study (0,96%) (Fig. 23). Among the "other reasons", sharing experience is the predominant with 25% of the choices (Fig. 24).



**Figure 23:** Purpose of the trip

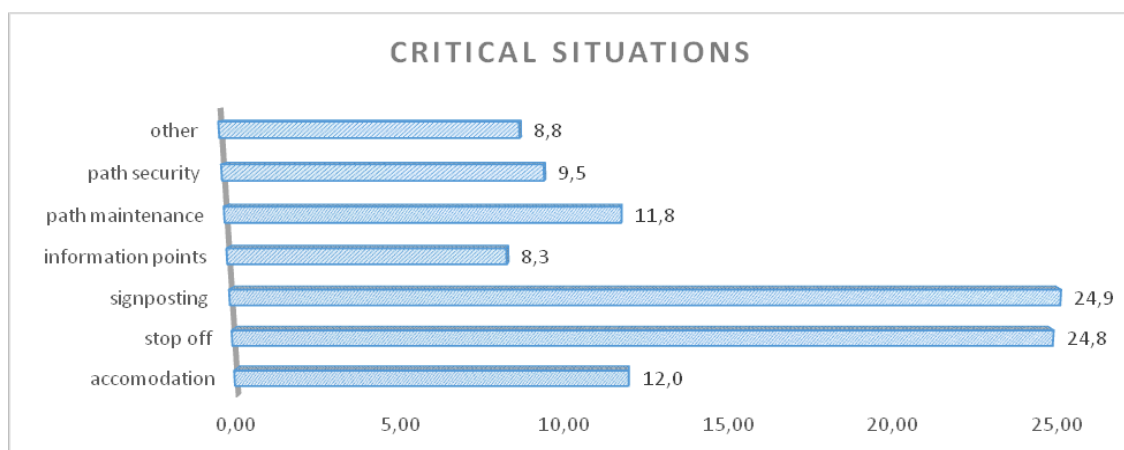


**Figure 24:** Percentages of “other reasons” indicated by the users.

## 2.9. Critical Situation

Regarding critical situations found along the way, the questionnaire asks to choose between accommodations, stop off, signposting, information points, path maintenance, path security, other reasons. Also in this case for multiple selections has been calculated a score.

The main problem identified by the users is the signposting (24.9% of the vote), specifically lack of signals in some parts of the route and lack of kilometers distances on signage. For the stop off option (24.8%) users report: difficulty in finding restaurants or delicatessen; benches and break points lack. The 28% of those who chose the “stop off” option, identified the lack of water supply points as most important critical problem. Accommodations (12%) result to be few (especially in low season), too expensive and badly reported by the guides. The path maintenance is indicated by 11.8% of users (mainly infesting vegetation cutting), while the path security (9,5%) concerns the presence of not protected paved roads and the road traffic.



**Figure 25:** Critical situation found along the path



### 2.10. How Did People Learn About The Via Francigena

The main knowledge sources of the Via Francigena are: friends or family (28%), other pilgrimages (about 20%) and through websites (19%). Among those who have made other pilgrimages, 63% walked the Santiago pilgrimage route.

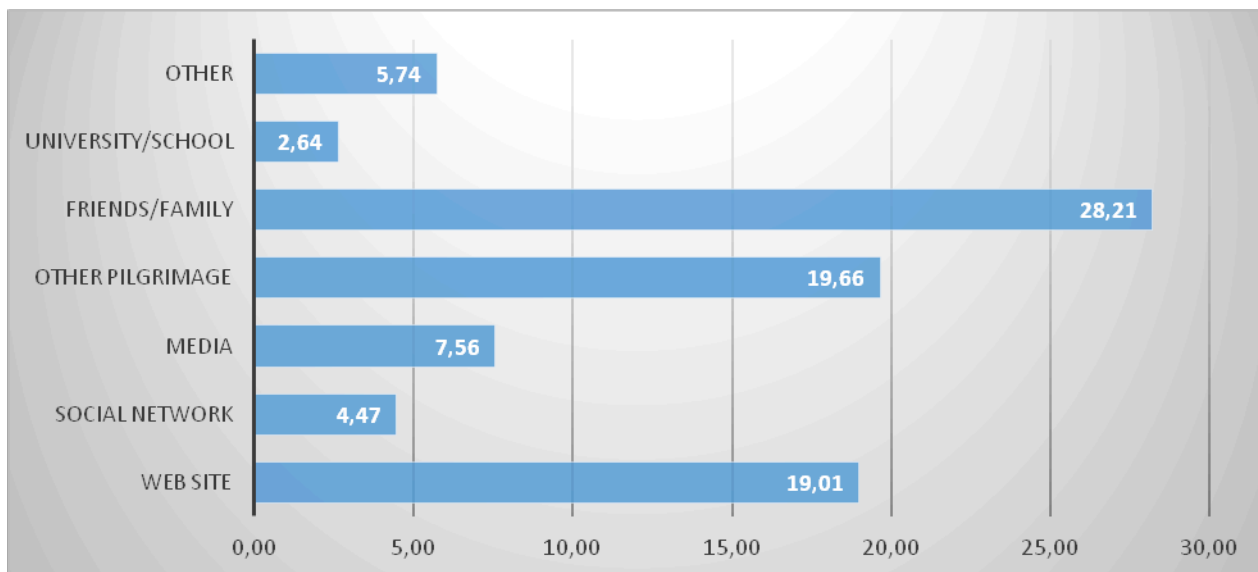


Figure 26: Via Francigena knowledge sources

### 2.11. Guiding Tool

The most widely used guide by the users is the paper guide (35,70%), followed by the web site track (22,49%). The map is chosen by 19,29% of those surveyed.

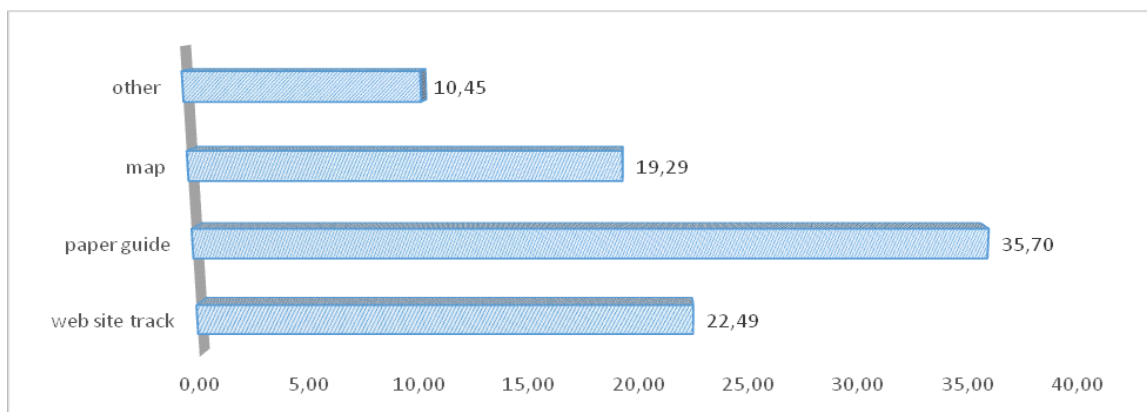


Figure 27: Guiding tool percentage

## Conclusions

The data collected during in 15 sampling months shows a growing phenomenon of "pilgrimage" along the Francigena route. These data allowed us to define the user profile of the Via Francigena in Tuscany.

The modern pilgrim is a traveler who enjoys the path in the spring and summer, with presence peak for the months of April, May and August. However, there is a good presence even for the autumn months. These findings have been confirmed by cross-checking with camera trap data.

The modern pilgrim covers the age groups 51 to 60 (20.4%) and over 60 (23.3%), confirming other surveys results. Well represented are also the intermediate age groups 31-40 (11.4%) and 41-50 (15.6%). This shows how the pilgrimage routes are spreading among the younger age groups.

Regarding the distribution between genders, these are well balanced between men, which prevail with 50-60%, and women, located between 40-50%. Among those who travel "alone", the male percentage is higher with 66% of total surveyed.

The Tuscan path is more frequented by Italians (60%) compared to users from other countries covering 40% of the total. Is however observed a greater variety of countries represented, with the highest percentages for France, Germany, England, Switzerland.

The most widespread use target is "on foot", with no significant numbers for those traveling by bike or on horseback. The time that user spends on the road is between 10 and 20 day stay, with difference between the foreigners who prefer longer periods of permanence (even higher than 50 days) and Italian users who travel the francigena for shorter periods and several times during the year. The favorite stops of the Tuscan section are those from Lucca to Rome, finish line for the 40% of sampled.

The modern pilgrim (for the Tuscan path) travels mainly in groups or in pairs. The solitary journey is the least preferred. Foreign pilgrims prefer traveling in a group compared to Italian pilgrims.

The modern user still prefers the classic paper guide to direct his journey. However, he also makes use of innovative techniques by downloading tracks from the web to GPS or Smartphone App.

An important data emerging from the analysis is that religious motivation is no more prevalent. The modern pilgrim is still motivated by personal research and spiritual reasons, but mainly moved by a naturalistic and environmental motivation, expressing the need for a experiential journey, related to rural areas and landscape that characterizes them.

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