

ANIMOVE: A FREE AND OPEN SOURCE FRAMEWORK FOR THE ANALYSIS OF ANIMAL MOVEMENTS WITH QGIS

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Abstract - In 2022, the QGIS software will be 20 years old. This program has the characteristics of being free and open-source and this allows to have access to the code and be able to improve it, but above all it allows to implement plugins that, exploiting the core-software, perform specific algorithms. Here, we presented the AniMove plugin, adapted to version 3.xx of the QGIS program. This plugin allows to perform the main calculation operations about the HomeRange evaluation (MCP, Random HR, Random HR path), and some tools to estimation of the Kernel Densities. For all the algorithms used, there is the possibility of varying different calculation parameters. The plugin, already fully functional, maintains, however, a framework logic, that is to be expandable and integrable with new routines and calculation algorithms that can be interesting in the world of applied zoology analysis and radio tagging. The tool is already fully integrated with the hundreds of features in QGIS, and it is easy to create models that extend its capabilities, e.g., land use, social indices, etc. Further development will automate some of these features to create an animal movement analysis suite.



The origins of GIS software are closely related to forest management or urban planning, yet in recent decades many other disciplines have incorporated GIS software as a tool. The interest of scientists in using QGIS in new fields of study seems related to the development of new functions and plugins. **QGIS** is the most widely used free and open-source geospatial software in the world. Among the main strengths of this geographic information system are: incorporation of tools via plugins and a growing community of users and developers.

Rosas-Chavoya et al. (2022) conducted a bibliometric analysis of papers published on Scopus from 2005 to 2020 (931 manuscripts). The annual rate of increase in publications was 40.3%. Seventy-two percent (fig. 1) of the publications were in six fields of study, of which Earth and Planetary Sciences (15.4 %) and Environmental Science (14.2 %) were the most representative. Italy was the country with the highest scientific output, while the United States was the most influential country (being the first, in terms of number of citations). In terms of countries, the largest number of articles found were from Portugal, Italy, Brazil and France. There is a growing trend of acceptance of QGIS worldwide and widespread development of collaborative networks.

We believe the problem could be solved by the use of several free and open source programs, available both for GNU/Linux, Mac OSX and MS Windows operating systems. We aim at producing the most advanced software. All resulting software is and will be freely available (under GPL or similar licences).

Our approach is to use simply QGIS to run many useful analyses (e.g. basic statistics, Minimum Convex Polygon).

For more advanced analyses, we have developed AniMove plugin (Faunalia, 2018). Developing python plugins for QGIS is easy, cheap, and fast. Our aim is to have a toolbox in which anybody can add her/his own preferred analyses.

AniMove algorithms for QGIS

QGIS provides a processing environment that can be used to call native and third party algorithms, making your spatial analysis tasks more productive and easy to accomplish.

AniMove plugin implements, as a processing submodule, kernel analyses with the following algorithms:

- **href**: the *reference* bandwidth is used in the estimation.
- **LSCV (The Least Square Cross Validation)**: the *LSCV* bandwidth is used in the estimation.
- **Scott's Rule of Thumb**: the Scott's rule of thumb is used for bandwidth estimation.
- **Silverman's Rule of Thumb**: the Silverman's rule of thumb is used for bandwidth estimation.
- **kernel with adjusted h**

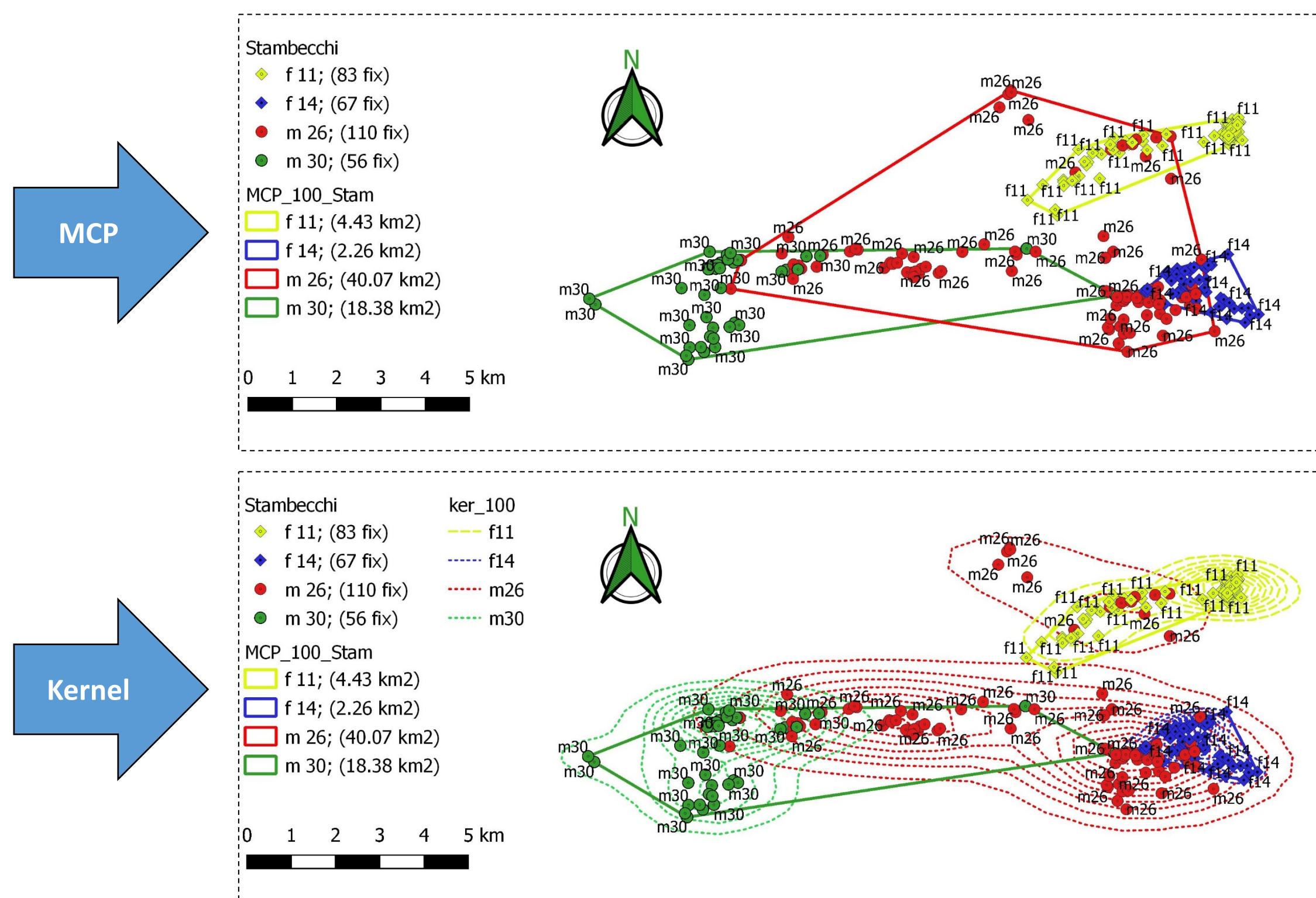
Utilization distribution and contour lines are produced, and area of the contour polygons are calculated.

Additionally, restricted Minimum Convex Polygons (MCP) are implemented, as:

- MCP calculation of the smallest convex polygon enclosing all the relocations of the animal, excluding an user-selected percentage of locations furthest from a centre.

Some of the bandwidth methods are only available with *statsmodels* (LSCV, maximum-likelihood cross-validation).

- A new tool called "Random path" that allows to randomize paths (lines) with many options: keep angles, randomize angles (range as user choice), randomize starting points, keep starting points, use a point layer for starting points, check if the random path crosses features of a specified line/polygon layer.

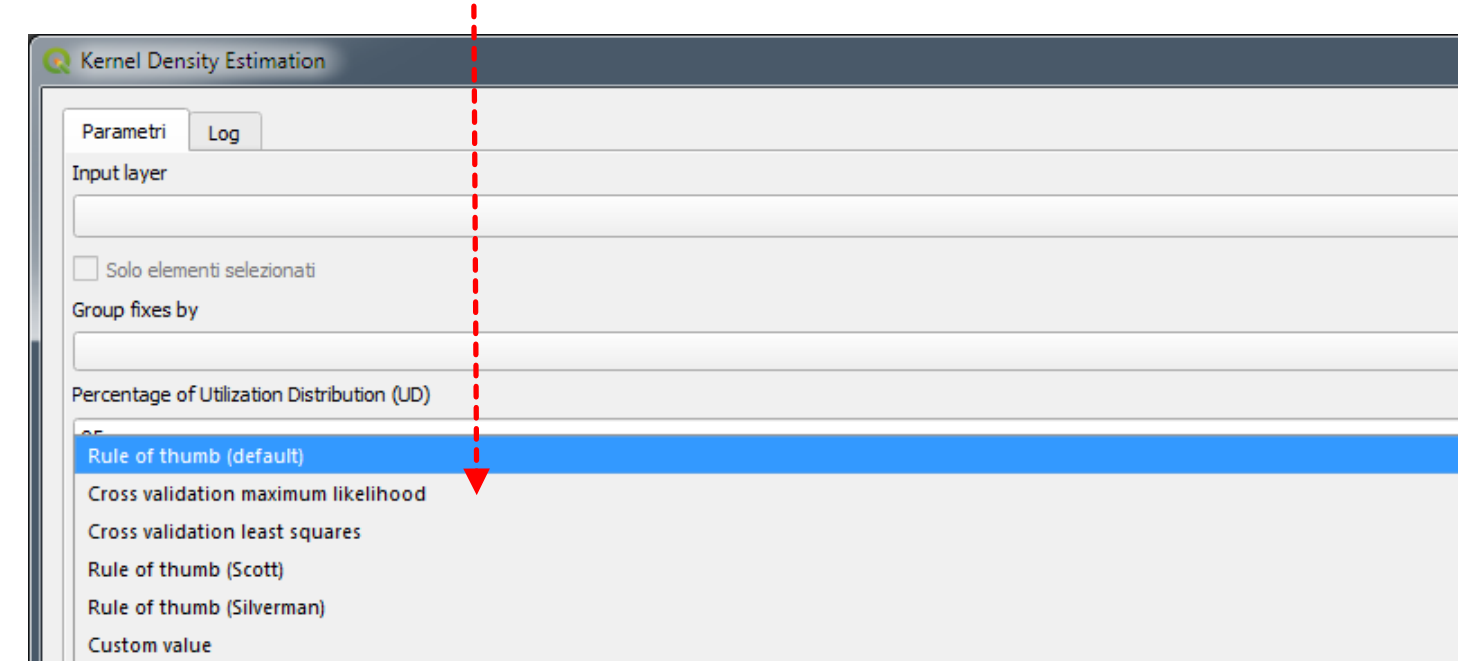
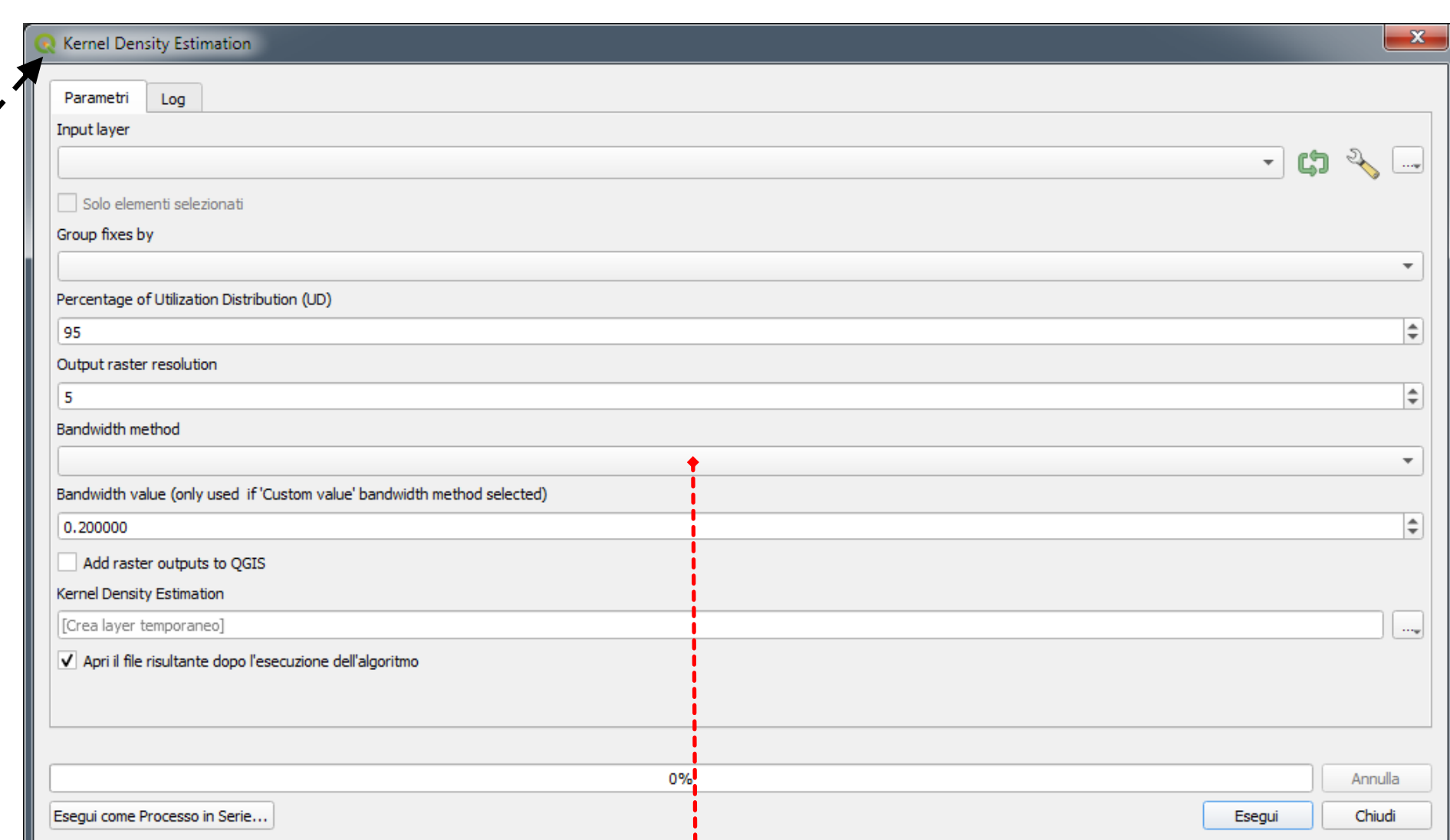
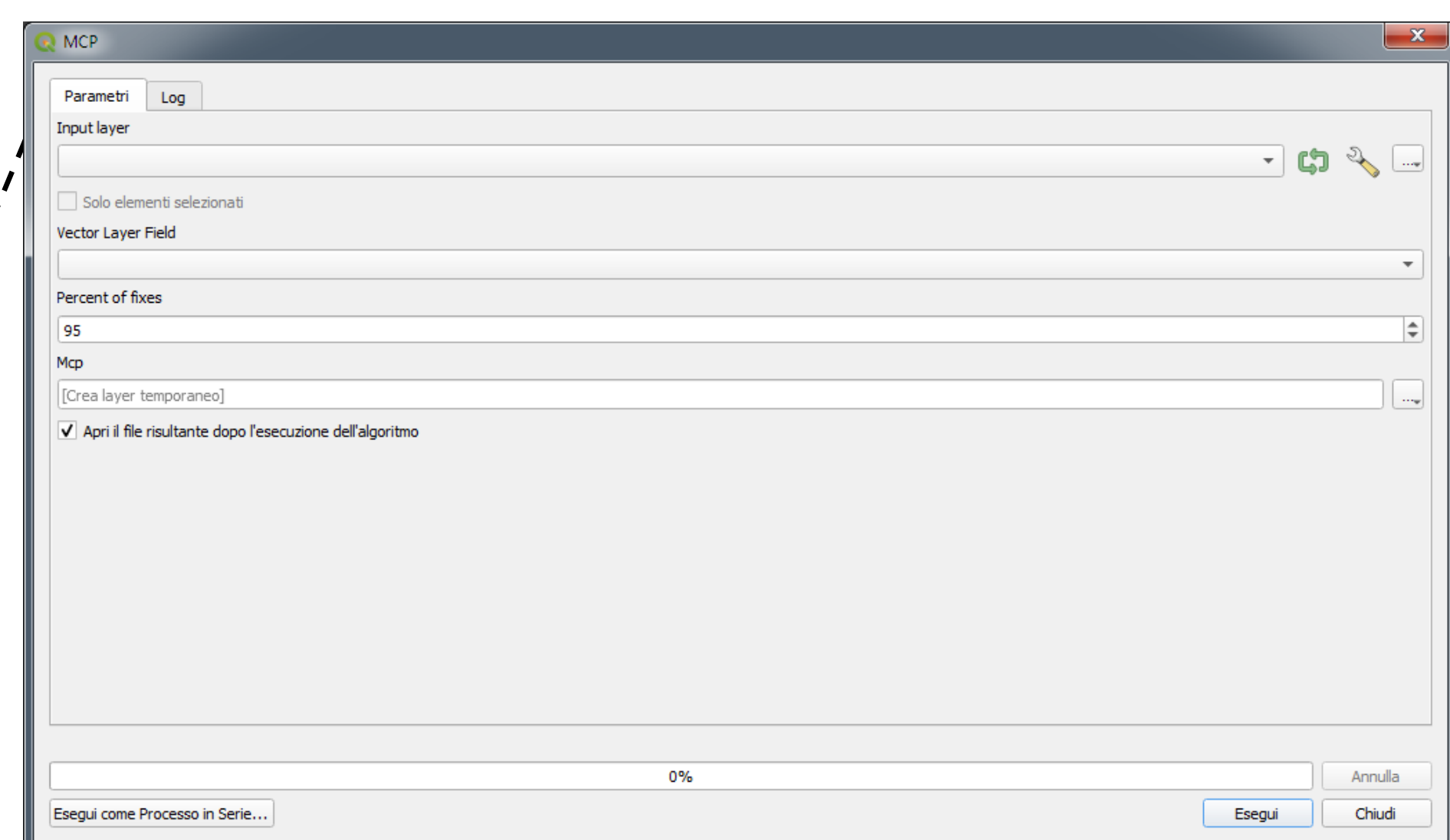
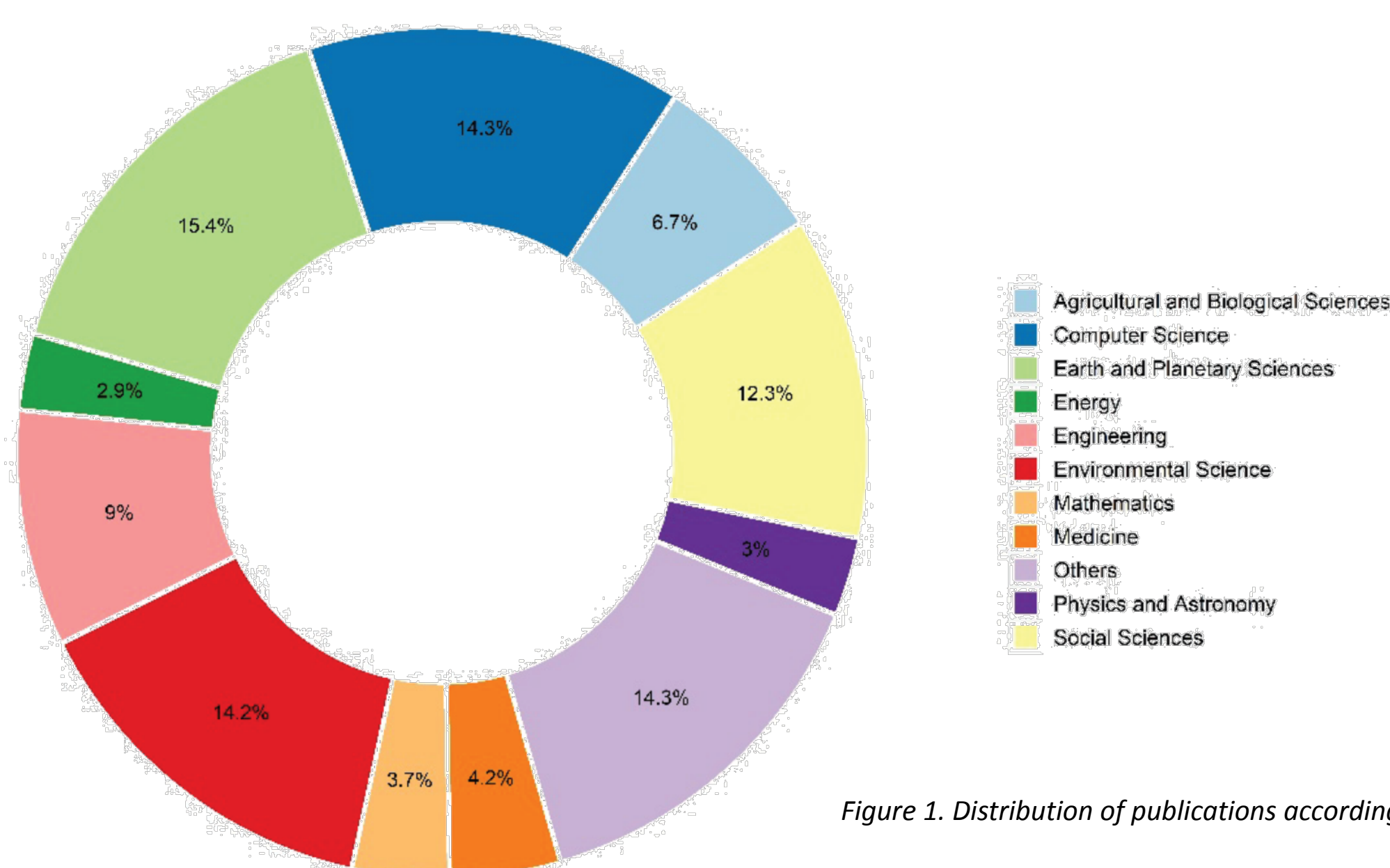


QGIS + AniMove provide, in a free and open-source environment, a powerful and advanced tool for processing zoological data from telemetry surveys, covering a scientific aspect that has been missing until now.

References

Faunalia (2018) <https://www.faunalia.eu/en/dev/animove>

Rosas-Chavoya, M., Gallardo-Salazar, J.L., López-Serrano, P.M., Alcántara-Concepción, P.C., León-Miranda, A.K. 2022. QGIS a constatly growing free and open-source geospatial software contributing to scientific development. *Cuadernos de Investigación Geográfica* 48. <http://doi.org/10.18172/cig.5143>



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DOWNLOAD AniMove plugin

<https://gitlab.com/faunalia/animove/-/blob/master/README.md>

