

## **Scientific report of Short Term Scientific Mission:**

### **“More than just where they go: Quantitative visualisation of animal migration tracks”**

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*Andrea Kölzsch*

#### **Purpose of the visit**

Initially, this collaboration between visualisation scientists of the giCentre and movement ecologists from the Netherlands Institute of Ecology (NIOO) started during a (COST-Move funded) workshop in July 2011. There, a small project was set up to improve visualisation designs for bird migration in time and space using GPS tracking data. However, the preliminary prototype still showed many shortcomings.

To solve these and bring the ideas of informed migration visualisation further, Andrea went on an STSM to the giCentre. During that visit, the partners aimed at discussing recently used bird migration designs and improve them in a systematic, question-oriented way. The developed visualisation designs should be implemented using real GPS tracks of migratory geese and plans for a publication of the findings were to be specified. Furthermore, both partners should learn from each other about their respective expertise, visualisation methods and migration ecology.

#### **Work carried out**

In preparation for the STSM, an overview of ecological publications and books that visually present bird migration tracking data was compiled. This list of visualisations was discussed within the Movement Ecology Group of the NIOO, identifying priorities that should be addressed with visualisation designs to be developed during the visit of Andrea at the giCentre.

As planned, the visit started with an introduction of Andrea to the group of the giCentre on 18 February 2013, where she gave a short **talk** about her work related to bird migration timing using GPS tracks. A very active discussion after the talk gave first indications of possible visualisation attempts. Following this, in a small **workshop**, Andrea, Aidan and Jo narrowed down the ecological questions to be addressed in the attempted visualisation design, and first ideas of designs were discussed.

During the following days, Andrea prepared real GPS migration data of two species of geese that were then to be used for testing and evaluating different visualisation design ideas. Additional measures were calculated from the raw data to show certain aspects of migration. In close cooperation with Aidan, data formats were adapted and an algorithm for producing migration visualisation designs was set up. To define our focus explicitly, a table with research questions was compiled, on which designs were later evaluated. After discussion about the eligibility of several visualisation designs, Aidan implemented a number of

examples using the goose GPS data. One afternoon, Andrea joined the weekly group meeting of the giCentre and learned about how visualisation scientists approach development of user applications, such as museum guides.

In a second **workshop**, on 21 February 2013, Andrea, Aidan, Jo and Jason discussed the produced migration visualisation designs. Methodological questions were solved, design possibilities expanded and the idea of a framework structure for presenting the design approaches defined. It was agreed to attempt writing a short paper for submission to the EnvirVis 2013 workshop that is organised within the EuroVis 2013 conference.

Because of common features of animal movement and bike tracks, Andrea discussed with Roger about his PhD work on the London borrow bike data set. Methods of how to cluster positions in space and time were found to be of concern to both and were exchanged.

Concerning the goose visualisation design, Andrea and Aidan discussed specific features of how to present distances and timing, which colour schemes to use and what is the value of simple data presentations vs. informed, question-oriented visualisations. A structure for the EnvirVis paper was developed, a set of informative visualisation designs decided upon and additional publications searched. A first version of a paper was written and sent around by Andrea to Aidan, Jo and Jason for comments.

The layout and content of this paper was discussed in a small third **workshop** on 26 February 2013 by Andrea, Aidan, Jo and Jason. Main points were to be more specific about the addressed research questions, the information channels that can be used for a visualisation and a framework of how to combine the two in a most optimal way. Design details were addressed to allow easy understanding of the visual designs by ecologists.

During the remaining days of the visit, migration visualisation designs were discussed in the weekly group meeting of the whole group and in more detail between Andrea and Aidan. The idea of using a map for additional information was further explored, testing different colour schemes and map projections. General and specific comments were included into the EnvirVis paper and the evaluation and discussion were written up.

On the last day, in short individual meetings of Andrea with Aidan, Jason and Jo, plans for the following days and future collaborations were laid out. Comments on the paper were exchanged and Aidan created additional visualisations. In the week after return from the STSM, Andrea **submitted** a short paper, named “Visualisation design for representing bird migration tracks in time and space”, to the EnvirVis 2013 workshop.

## **Main results**

The main scientific outcome of this STSM is the **short paper** on bird migration visualisation possibilities having been submitted to a workshop within the EuroVis 2013 conference (see Appendix). It describes most of the developed design considerations and bird migration visualisations in relation to scientific questions. We are confident that after further development and evaluation of the designs they can be used by the ecological community to visually analyse tracking data in a more focussed manner.

This leads to another result of the visit to the giCentre: Andrea has got a deeper insight into the importance and value of structured, question-oriented designs of visual representations of spatio-temporal data sets, such as bird migration tracks. She learned about the capacity of different information carrying channels in visualisations, the possibilities of using different colour schemes and different map projections. On the other hand, members of the giCentre have got to hear about the ecological complexity of animal movement and present challenges of migration ecologists.

### **Future collaboration and publications**

The submission of the short paper to the EnvirVis 2013 workshop within the EuroVis 2013 conference lays out plans for future collaboration. If the paper gets accepted, we intend to present the visualisation design and framework at the conference and discuss it there. Thereafter, we aim to extend the work, evaluate the scientific questions and improve the visualisation design to be published in a methodological journal for the ecological community (e.g. *Methods in Ecology and Evolution*).