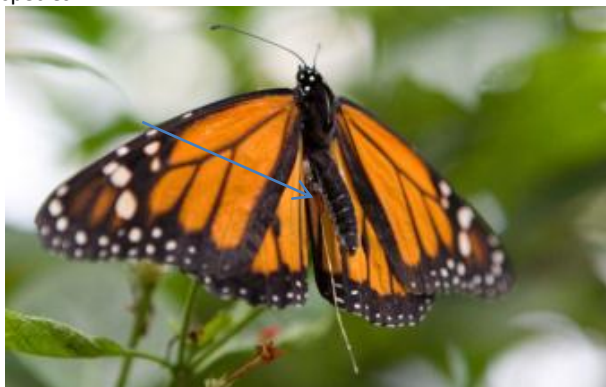


The first reports for migration of wild animals date from over 3000 years (Aristotle). The paths of migrating birds are very important for the people, they are also the paths of spread of deadly diseases.

In 2004, in the time of the "bird flu" pandemic, the virus develops in south China and for a short time reaches Europe. The World Health Organization estimates the economic losses from the pandemic for about \$800 billions. The virus has affected 562 man, 60% of them die. The study of migration is important for protection of threatened from disappearance species.



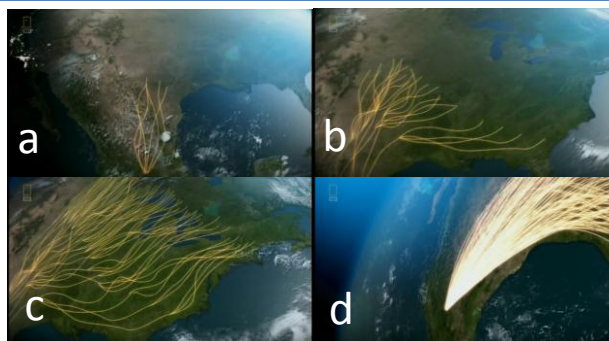
Picture 1. Monarch butterfly with attached receiver on her.

Migration with change of generations

The Monarch butterfly is unique migrator (picture 1), flying over 3000 km between Mexico and Canada. The northward migration is done by three generations of butterflies. The southward migration is done by the fourth super generation with lifetime 10 times longer than the life of his parents. It has also better life indicators. This type of migrations are incredibly rear.

Monitoring of migrations

The monitoring of the butterflies is possible with placement of receiver of Global Navigation Satellite Systems (GNSS), as shown with blue arrow on picture 1. Collected information for the location is processed to obtain the trajectory of migration (picture 2).



Picture 2. Trajectory of northward migration from Mexico to Canada (a, b, c) and southward (d).

Global Navigation Satellite Systems (GNSS)

- *GPS (USA) – complete configuration 1995.
- *GLONASS (Russia) – complete configuration 2009.
- *GALILEO (EC/ESA) – planned complete configuration 2015.
- *COMPASS (China) – planned complete configuration 2020.



Picture 3. GNSS configuration GLONASS (left) and GPS (right).

GLONASS configuration

- *24 satellites of II generation
- *Height of orbit – 19 100 km
- *64,8° inclination of orbit
- *More precisely collecting of information from sub polar regions

Position determination

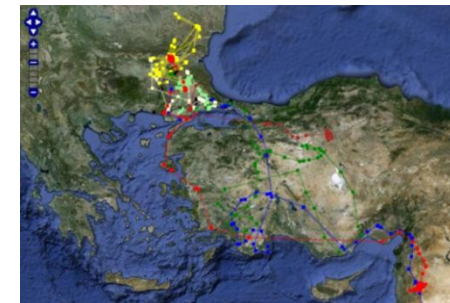
Position determination is identical for all GNSS systems. The satellite sends a signal carrying information about the exact moment in time, when the signal is generated. The receiver detects the exact time the signal reaches. The distance is calculated by multiplying the velocity and the signal travel time.



Picture 4. Positioning.

GNSS migration monitoring in Bulgaria

Bulgarian Bird Protection Association (BBPA) makes satellite tracing of young royal eagles, using GNSS technology. Movements of birds are monitored in real time by GNSS devices, placed on 7 young royal eagles in summer of 2009 within the project LIFE+ for protection of royal eagle and hunting falcon.



Picture 5. Trajectory of migration of royal eagles.

With satellite tracing (Picture 5) for first time were obtained the trajectories of young royal eagles migration. The analysis of collected data gives the opportunity to search for effective solutions for protection of this globally threatened species.