

1. Hye volunteers and welcome to the marmot project where you will help us to study the impact of climate change and marmots populations.

2. (3;4;5)Climate change are changes of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability, observed over comparable time periods.
 Climate change should lead to:
 - Disruption of the water cycle,
 - An increase in the frequency and intensity of natural climatic disasters (droughts, floods, storms, cyclones)
 - a modification of ecosystems directly linked to the loss of biodiversity.

6. Climate change have various impacts on marmots species :
 For example, if we compared data from 2 marmot species.
 First, the yellow-bellied marmot, *Marmota flaviventris*, from the eastern part of the USA and then the Alpine marmot, *Marmota marmota*, from the Alps
7. We can see that the response to climate change is very complex and sometimes opposite depending on species. For example if you compare these 2 species, climate change will in both cases modify marmot phenology.
8. Data collected between 1976 and 2008 on the yellow-bellied marmots of Gothic in Colorado shows that marmots emerge earlier and give birth earlier. Consequently, pups have more time to grow between emergence and hibernation. For all age classes, an increase of body mass is observed leading to better survival and reproduction. This influence the dynamic of the population and an increase of population growth is observed.
9. At the opposite, data collected between 1990 and 2011 on the Alpine marmots of La Grande Sassièrè show that climate change lead to a decrease of winter snow cover and that this decrease of snow leads to over-cunsumption of marmots fat reserve during hibernation.
 Consequently females are skinier than before and produce less pups.
 If climate change seems to have a positive effect on the yellow-bellied marmots, it has a negative effect on the Alpine marmots.

10. The French Alps is a good place to study climate change, because Alpine ecosystems are extremely sensitive to disruption, species are extremely adapted to environmental conditions and confined to altitude habitats and can not try to escape to climate change by migrating. Consequently, Alpine species are thought to be among the first species to be impacted by climate change.

11. The Alpine marmot is a good subject to study the impact of climate change on Alpine species, it will help us to understand, model and predict the impact of climate change on others species.
 She is highly adapted to Alpine environment and weather conditions
 She lives in altitude between 800 et 3000 meters

Due to the harsh environmental conditions that she has to face, she has evolved a complex social structure. She lives in a family group composed of a single dominant breeding couple, subordinates represented by adults of both sexes and pups of the year and where subordinates are needed to raise pups successfully.

Due to the high seasonal character of the environmental conditions, their annual activity is variable over time and highly conditioned on weather conditions. For example, they hibernate between mid-October and mid-April and are active only for the rest of the year, they mate immediately when waking up from hibernation to allow their pup to grow enough to survive their first hibernation: the pups are born at the beginning of June and they weigh around 20g, their mass will increase by more than 100 before mid-October. They also strongly modify their daily activity depending on weather conditions as a tactic to save energy.

12. Since 1990, 32 marmots' families are studied. It represents 1350 individuals followed.

13. Marmots are trapped with live-trap, baited with dandelions

14. Each family is counted

15. The Reserve Great Sassièrè, climatic conditions are measured throughout the year thanks to a weather station.

This station was partly funded by earthwatch volunteers

We thank them for their donations

16. Moreover, we carefully monitor temperature and snow cover in each burrow thanks to temperature and luminosity loggers.

17. To understand how climate change affects marmots, we need to know how environmental factors affect the energy budget and thus their fat consumption. To this purpose, we need to monitor their intra-abdominal temperature. We thus implanted a logger registering the marmot temperature every 2 minutes during 1 year. Later on, we will be able to see how environmental variables affect marmots' temperature and energy expenditures.

18. We also want to know how climate change affects the ecosystem marmots are living in.

Thanks to plant monitoring, we will be able to see how climate change affects food availability for marmots. For example, we follow the phenology of Pasque flower, edelweiss and Cobweb houseleek.

19. We also want to know how climate change affects small species like grass frog or green dock beetle.

20. We also study birds' migrations to know if climate change modifies their return to their breeding place.

These global monitoring can help us to generalize our findings to the other species of the Alpine ecosystem.

21. The marmots' project included other activities like sociality monitoring to know how the

social structure of the Alpine marmots can mitigate or amplify the effects of climate change we observed.

We also carefully monitor the marmots' reproduction since it is a capital parameter in population monitoring.

22 If you need more details, please refer to the field manual, the protocols manuals and don't hesitate to ask questions to me or any member of the team.

23. Have fun and enjoy your time with us.