

## ARGE-SCHNEE: AN ELABORATED TRAINING OF SEARCH- AND RESCUE (SAR) DOGS IN SNOW

Barbara Hinterstoisser<sup>1\*</sup>, and Walter Fretschner<sup>2</sup>

<sup>1</sup> *University of Natural Resources and Life Sciences, Vienna, Austria*

<sup>2</sup> *Rettungshundezug-Bibertal e.V., Rosstal, Germany*

**ABSTRACT:** Snow has proved to be a perfect terrain to start and to foster a SAR-dog training. As snow is nearly odourless it is perfect to draw the dogs attention on human scent only. Eliminating competing scents, like the one of smelly food or odorous toys, several points have to be considered. Fetid rewards overlap with the one dogs should search for - the human scent, which although consisting of a huge variety of volatile substances gives a characteristic "human scent pattern". In the training no food is used. Toys should be non or less smelly and are often alternated, to avoid their becoming part of the "human scent pattern". The snow training is strengthening the intensity of the search. The dog figures out quickly how to search for people and how to dig and to give a good bark while doing so. Dogs learn by means of continuous repetition and build up a positive expectation for the next assignment in the sense of: „Absolutely must have this“. For preparing the dogs also for rubble search a special grid is used to close the snow caves to block the entrance. The dogs learn to bark intensively to call for the handler to open the grid. Education in snow is a perfect start and motivation training for avalanche-, area- and rubble search!

**KEYWORDS:** Search & Recue Dogs, SAR dogs, training without dog-goodies, human scent

### 1. INTRODUCTION:

ARGE-SCHNEE is an association of SAR-dog handlers from Europe, of different organisations, who meet every winter to train together and exchange knowledge and experiences aiming to further improve their work. Goal is to improve the performance of SAR dogs teams in general and to increase the dogs motivation. Obviously this motivation can be fostered by having fun - that means to play. Prerequisite for the dog handlers is to learn how to play properly. Often dog handlers don't enjoy making a fool of themselves in front of their dogs (and surrounding people). But sometimes there's no way around it - plus it feels good ! An additional effect is, that the relationship between the dog handler and the dog is strengthened by that a lot (Miklósi and Topál 2013) and the relationship to humans in general can be improved - a side effect of immense importance in search and rescue training and action.

An quite often overlooked fact is that in snow going for the human scent can be put in the foreground much better than in other environments. SAR dogs have to search for human beings - so the dominant scent should be the human one. Any interference of other (intensive) scents hinders to focus the dogs bio-sensor "nose" on the human scent.

Snow is more or less odourless. In the snow environment interfering smells are reduced to a minimum. To further discuss this topic one has to have deep knowledge what scent is and how it develops and how it is detected by the dogs nose - the olfactory system.

The presented poster will focus on the theory of scent in general and why snow is perfect to focus the dogs on human scent.

### 2. STATE OF THE ART

For the SAR dog training science has to meet practical knowledge gained by many years of experience.

To bridge these two - often different - "planets", an intense discussion, space for exchange of knowledge and an open mind on both sides is necessary. Another often not recognized obstacle is the fact that humans try to read and interpret canines forgetting, that their world is a world of smell. Humans mainly use their visual sense. The dogs olfaction is their most important sense - much more sensitive than ours. It is known that they can detect scent concentration levels roughly 10.000–100.000 times that of humans (Craven et al. 2010).

What is human scent and which compounds could be part of scent in general? To be part of an odor a molecule has to be in the gas phase. Organic molecules in the gas phase are summarized as volatile organic compounds (VOC). Under room temperature typically molecules with a relative molecular mass

-----  
\* Barbara Hinterstoisser, University of Natural Resources and Life Sciences, Vienna, Austria;  
Peter Jordan Str 82, 1190 Wien, Austria  
tel.: +4314765489120  
email: barbara.hinterstoisser@boku.ac.at

between 30 and 300 g/mol (ca. 20 carbon atoms) are volatile, as these molecules have a low boiling point and high vapor pressure. Bigger molecules need much more energy to escape from the liquid (or solid) in the gas phase (Legrum W. 2015). Inorganic gases like Carbon dioxide, Nitrogen oxides, Sulfur oxides etc. fulfill these requirements as well. The bigger a molecule the higher is the boiling point, the lower is the vapor pressure. It is further important to know that when a liquid boils or evaporate to become a gas the molecules do not fall apart! Other crucial factors for volatilization beside the size of the molecules are the molecular geometry and the inter- and intramolecular interactions. The less the interaction between the molecules is, the easier it can evaporate (Moore & Hummel 1986). One special case is water - a result of its intermolecular hydrogen bonds (Jeffrey and Saenger 1994). Non-polar molecules are in general more volatile than polar ones. On the other hand compounds, recognised by the olfactory system have to fulfill the requirement to be at least a bit (water) soluble in the mucus of the nose (Frings and Müller 2014). Therefore the most odorous molecules often have one or two polar functional groups. More polar functional groups lead to less volatility (Gardner and Bartlett 1999) - again an effect of hydrogen bonds. Several attempts have been made to define and investigate human scent and to built artificial sensors for detection. One very much known compound is butyric acid (88,1g/mol), found in human sweat. But human scent includes many other VOCs as well as for example hydrogen sulfide. It differs from origin - whether it comes from the exhalation or different body areas (e.g. Mochalski et al. 2014; Vypelova et al. 2014; Szabo et al. 2015; Agapiou et al. 2015; Filipiak et al. 2016).

Substance	boiling point °C	molar mass (g/mol)
Methane (CH <sub>4</sub> )	-161,50 °C	16,04
O <sub>2</sub> (Oxygen)	-182,96 °C	32
H <sub>2</sub> S (Hydrogen Sulfide)	- 59,55 °C	34,08
CO <sub>2</sub> (carbon dioxid)	sublimiert -78,5	44,01
NO <sub>2</sub> (Nitrogen Dioxide)	21,2	46,0055
Isoprene (C <sub>5</sub> H <sub>8</sub> )	34,067 °C	68,12
Propionic acid (C <sub>3</sub> H <sub>6</sub> O <sub>2</sub> )	141,15	74,08
Butyric acid (C <sub>4</sub> H <sub>8</sub> O <sub>2</sub> )	163,7 °C	88,11
Isovaleric acid (C <sub>5</sub> H <sub>10</sub> O <sub>2</sub> )	177 °C	102,13

Tab. 1: Boiling points of selected gases at 1atm (= 1,01325 bar) that are part of human scent and/or exhalation

Table 1 shows boiling points of some substances known to be part of human scent and/or exhalation.

Human - dog relation is an other aspect to be included in elaborated dog training - again related to scent. Berns et al. (2015) showed, that the emotional reaction of a dog to the smell of a familiar person is stronger than to a conspecific. Kerepesi et al. (2015) describe investigated the extent to which dogs discriminate between familiar and unfamiliar persons.

### 3. CONSEQUENCES FOR SAR DOG WORK:

An important aspect that plays a major role in SAR dog work is the temperature of the human body and the temperature of the environment. A warm, living, active body excretes more odor than a hardly living, cold body. A dead body segregates mostly a lot of smell, as in warm environment microbiological degradation starts and low molecular substances appear. A warm body in warm environment (summer time, forest area, meadow, rubble field...) releases much more odor-molecules than a warm body in cold environment and has in general more odor competitors to its human scent. A warm body in cold environment (e.g. snow) in general has less odor competitors, as the low temperature hinders molecules to evaporate.

This leads to the conclusion, that the main odor in clean snow is the one of the hidden person. The human scent becomes the most prominent smell for the dog. Beginners get to know this "human scent pattern" they have to search for. Experienced dogs could refresh this olfactory picture easily, working in the snow.

This is just possible, if no food is with the hidden person, if no stinky toy is used. One has to be aware that in real search actions quite often some food and other stuff lies around. This is true in an avalanche accident with involved humans and even more in rubble fields after an earthquake or explosion, in landslides and even ordinary area fields where the dog has to search for persons. It is therefore very important, that food or other smelly stuff does not harm the search activity of the dog longing to find human beings. This is was also of dramatic importance in a search and rescue action at Dhaulagiri and Annapurna in Nepal, when people trekking in that area had been missing (Dura 2018).

As playing is highly motivation for the dog, toys are important to work with. Figure 1 shows a SAR dog after finding a hidden person returning with a toy presenting it proudly to its handler. Known from dog training is, that the hidden person (the assistant) should/could have a motivation-toy with him. Important is to be aware, that these toys should be clean and not smelly at all. Best is, to use different ones, not to

overlap the human scent pattern with a single, specific toy odor. SAR dogs have to search for human beings - so the dominant scent should always be the human one. The human scent should be the scent they are longing for. Any interference of other (intensive) scents hinders the dogs to focus on the human scent and so the person he has to search for.



Fig 1: SAR dog successfully after finding a hidden person, that played with him

In the snow-training the dogs get into their job step by step. They learn to search and to get as close as possible - by e.g. digging - to the hidden person, and also to bark when they find the person.

#### 4. CONCLUDING REMARK

Taking into account all these facts, the training of SAR-dogs has to be elaborated in a much more sophisticated way than it is mostly done. Fast success in sport competitions of Search-dog-teams seem sometimes to be more important, than reliable well trained teams for real disaster relief missions. Human scent as the only goal and a reliable, thoughtful search should be achieved by following the advice not to use smelly stuff in SAR dog education that could interfere with the human scent.

#### 5. REFERENCES

Agapiou, A., Amann, A., Mochalski, P., Statheropoulos, M. and Thomas C.L.P. (2015) Trace Detection of Endogenous Human Volatile Organic Compounds for Search, rescue and emergency Applications. *Trends in Analytical Chemistry* 66, 158-175

Berns, G.S., Brooks, A.M. and Spivak, M. (2015) Scent of Familiar: An fMRI study of canine brain Responses to Familiar and Unfamiliar Human and Dog Odors. *Behavioural Processes*, 110, 37-46

Craven, B.A., Paterson, E.G. and Settles, G.S. (2010) The fluid dynamics of canine olfaction: unique nasal airflow patterns as an explanation of macrosmia. *J. R. Soc. Interface*, 7, 933-943

Dura, K.B. (2018) personal communication, SAR-dogs Nepal

Filipiak, W., Mochalski, P., Filipiak, A., Ager, C., Cumeras, R., Davis, C.E., Agapiou, A., Unterkofler, K. and Troppmair, J. (2016) A Compendium of Volatile Organic Compounds (VOCs) Released By Human Cell Lines. *Current Medicinal Chemistry*, 23, 2112-2131

Frings, St. and Müller, F. (2014) *Biologie der Sinne: Vom Molekül zur Wahrnehmung*. Springer-Verlag, Berlin Heidelberg, ISBN 978-3-8274-2272-9

Gardner, J. W. and Bartlett, P.N. (1999) *Electronic Noses Principles and Applications* Oxford University Press, Oxford, UK,

Jeffrey, G.A. and Saenger, W. (1994) *Hydrogen Bonding in Biological Structures*, Springer-Verlag, Berlin-Heidelberg-New York, 2nd ed. ISBN 3-540-57903-6

Kerepesi, A., Doka, A. and Miklósi, Á. (2015) Dogs and their Human Companions: The Effect of Familiarity on dog-Human interactions. *Behavioural Processes*, 110, 27-36

Legrum W.: *Riechstoffe, zwischen Gestank und Duft; Vorkommen, Eigenschaften und Anwendungen von Riechstoffen und anderen Gemischen*, Studienbücher Chemie, Verlag Springer Spektrum, Wiesbaden 2015, 2. Auflage, ISBN 978-3-658-07309-1

Miklósi, Á. and Topál, J. (2013) What does it take to become "best friends"? Evolutionary changes in canine social competence. *Trends in Cognitive Sciences*, 17: 287-294

Mochalski, P., King, J., Unterkofler, K., Hinterhuber, H. and Amann, A. (2014) Emission rates of selected volatile organic compounds from skin of healthy volunteers. *Journal of Chromatography B*, 959, 62-70

Moore W. J., Hummel D. O. : *Physikalische Chemie*, Verlag Walter de Gruyter Berlin, New York 1986, 4. Auflage, ISBN 3-11-010979-4 .

Szabo, A., Ruzsanyi, V., Unterkofler, K., Mohacsi, A., Tuboly, E., Boros, M., Szabo, G., Hinterhuber, H. and Amann, A. (2015) Exhaled Methane Concentration profiles during exercise on an ergometer. *J. Breath Res.* 9 016009

Vyplelova, P., Vokalek, V., Pinc, L., Pacakova, Z., Bartos, L., Santariva, M. and Capkova, Z. (2014) Individual Human Odor Fallout as Detected by Trained Canines. *Forensic Science International* 234, 13-15