

# SEARCH DOG HANDBOOK



Facts and Figures  
for the

**SEARCH MANAGER**

**DEDICATED TO**  
**Dog Handlers**  
**Carrie of Canada**  
**and Karyl of the USA**

Also dedicated to the people who manage search resources.

Many thanks to Hatch Graham, Sandy Bryson, Marcia Koenig and the Boxwood Press for the material for this handbook.

Many thanks as well, to the folks, both dog handlers and search managers, who kindly shared their thoughts with me about the content of the handbook.

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## Acknowledgements

Sometimes I get really excited when writing a manual or article. That's the feeling I had when I talked with some of the authors of the books used in my research, because they were very helpful and supportive, and enthusiastic about this project.

So, my thanks go out to the following people for allowing excerpts of their publications to be included in this handbook.

Sandy Bryson, author of *Search Dog Training*  
Published by The Boxwood Press, 183 Ocean View Blvd., Pacific Grove, CA, 93950

Hatch Graham, author of *77 Fact about Search Dogs*

Marcia Koenig, author of *Wilderness Search Strategy for Dog Handlers*

Material also excerpted from *Scent and the Scenting Dog*  
By William G. Syrotuck (deceased)

## Preface

From time to time search dogs are used on a SAR mission. How should they be used? What are their qualifications? How have they been trained?

These and other questions come up when managing a search. I looked around for a small handbook about dogs and handlers which would answer these questions, and which would be handy in my pocket. Couldn't find one. So I wrote this one. Well, I didn't really write it - this handbook is a compilation from several different sources, who are mentioned in the Acknowledgement, and who were kind enough to allow me to extract the facts and figures from their books.

If one takes the time to plan the search and allocate resources to area segments which maximize efficiency/thoroughness, is there enough known about the dog and handler team resource to place the team in the right area, at the right time?

**Tip:** Invite the dog handler into the search planning session.

This handbook provides facts and figures about search dogs for Search Managers and Overhead Management teams. I hope it answers many of the questions which may come up during a search.

How search dogs are trained is the subject material of numerous books, and is not included here (or this would also become a book).

I hope you find it of value for general information and search planning.

Many thanks go out to the reviewers of this handbook. Their comments were valuable and most appreciated.

*Mike Doyle*

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# SECTION 1

## *77 FACTS ABOUT SEARCH DOGS*

*Answers for search managers and dog handlers.*

*“77 FACTS” by Hatch Graham, CARDA, California.*

*Presented September 1982 at the annual conference of NASAR. Revised 1990.*

This first section is a summary of facts and figures. More detailed information may be found in the sections which follow.

### THE TEAM

- 1) A search dog team consists of two (1 dog and 1 handler).
- 2) A search dog team is no better than it's weakest link - to meet expectations, the handler must be fit, search-wise, know his way around the country, be fully equipped, and believe his/her dog - who is usually the stronger link.
- 3) A search dog team needs to know:
  - Where to look and sniff.
  - How to cover the area to scent and see.
  - How to avoid other searchers.
- 4) A search dog team will often want to search the perimeter of its assigned sector first:
  - To cut for tracks - scent or sign.
  - To learn the boundaries of the assignment.
  - To check weather (wind speed, direction, irregularities).

- 5) A search dog team will prefer to search into the wind:
- Zigzagging into the wind on small areas.
  - Parallel sweeps across the wind on larger areas.
  - Often along ridges and downhill with normal daytime updrafts.
  - Often up canyons and uphill, in morning and evening shadows when there are normally downdrafts.
- 6) A search dog team (at least the handler) will want a good map and orientation. More than most searchers, search dog teams are often on their own. *Ed. Note: Many Search Managers will send a tracking aware searcher with the handler for safety, and to keep track of location and handle communications. This person can check an area when, for instance, a dog is working a scent pool.*
- 7) A search dog team will need communications with search base. Most teams have their own radios but agencies should have the usual *common frequency for Canada and the U.S. \*added Ed.*
- 8) A search dog team is effective at night:
- Probability of detection is much greater at night.
  - Handler safety in terrain is the only reason to hold back search dog teams at night on a high priority search.
- 9) Other than night-time, early morning, late afternoon and evening are the best times for a search dog team. Midday convection currents in summer decrease a dog's effectiveness.

## APPLICATION

- 10) The search dog team can search by air scent or wind scent within 15 minutes after other searchers have cleared the area. For air scenting, it does not matter how many have been there before or how long since the subject has been missing. *(It helps if searchers haven't contaminated the area.)*
- 11) Many air scenting dogs are cross-trained to trail or track and can do so if the area is undisturbed and the track is not too old.

12) A scent article is useful:

-It must be uncontaminated by others than subject. (*Upper body garment works very well*)

-If touched by others the dog should meet them so he knows they are not the subject.

-Carry it in a Ziploc or paper bag. (*No colored plastic bags. Use bag turned inside out or pick up item, or, use metal tongs or coat hanger. Mark bag with date, time and name.*)

13) A search dog is useful for covering large areas fast, with the least amount of forces committed to the search.

14) A search dog can search shrubbery, crawl spaces, and outbuildings in urban settings on house-to-house searches.

15) Some search dogs can work debris from floods, mudslides, tornadoes, explosions, plane crashes and earthquakes.

16) Some search dogs can work avalanches.

17) Some search dogs can search for evidence of crime.

18) Search dogs can locate drowned people in the bottom of lakes, *or in rivers, or all bodies of water*. Gases escaping from bodies rise to the surface and a dog in a boat will give an accurate indication.

## HOW IT WORKS

19) Bodies, alive or dead, give off rafts of cells and gases and vapors constantly.

20) At least one third of cells emitted from humans are lighter than air (.014 microns or smaller) and stay suspended.

21) These airborne cells and odors act like smoke.

22) During calm days, with the sun over head, smoke and scent rise up from convective currents. This is the toughest time for dogs.

23) Wind will shear the convective column over along the ground and overcome the problem.

24) Cloudy days (low or mid-level clouds) reduce convection and dogs do better.

25) Mornings and evenings and winter, when shadows are longer (the sun isn't overhead), are better for dogs

26) There is no convection at night, which is great for the dogs, usually.

27) On cold, dead calm nights, warmth of live bodies will cause some convective lift, which can cause a problem on flat terrain. On hills, there will usually be downslope laminar flow of air to overcome this.

## SCENT PLUMES

28) Scent plumes, like smoke, fall into several patterns depending on the weather:

**FUMIGATING** night-time inversions break with morning sun and bring scents down into valleys and low spots. A subject on a hillside may be detected by a dog down below easily at this time. Dogs should be in the field before sunup.

**LOFTING** is the reverse of fumigating. Stable air at the surface with unstable air aloft. Lofting happens after the sun sets and the ground is cooling but the air aloft is still warm, typical of valleys in the late afternoon and elsewhere in the early evening. On calm evenings where this situation occurs, handlers should work their dogs along ridges and higher slopes. *\*added Ed.*

29) **FANNING PLUMES** occur at night in stable air. Scent will hold at the same elevation level. A dog may alert on a victim across a canyon at the same elevation but have no way to follow to him. Handlers should report alerts. A series of night-time alerts at the same elevation is an important clue: check elsewhere at that elevation.

30) **CONING PLUMES** are typical on cloud covered days and is the best thing going for air scenting dogs.

31) **LOOPING PLUMES** are typical of clear or high cloudy days, and midday, high convection situations. Scent will rise up, cool, loop back down, heat up again, rise back up, etc. The dog will alert, put its head up, then lose the scent. An experienced handler will mark the map and possibly can get a direction from a line of these alerts. Sometimes several dogs in the field will establish the line over half a mile or so in this way, pointing to the subject.

32) Wind carries scent to the dog, but also disperses it. Convection disperses it too, even more so. At 100 meters from the source, at noon, on a clear, windless day the dog will receive 2% of the scent that he would receive on a clear night. A 12 MPH [19KPH] wind will equalize the situation, and he will catch 10-25% of the scent.

#### PROBABILITY OF DETECTION (POD)

33) POD varies for search dog teams according to wind, convection, terrain and vegetation barriers.

34) The handler part of the team will run at 50% POD just like a grid searcher at 100 ft.[30m], except the dog handler will be covering about one-third of the country (16.5%), since the handler is more likely gridding at 300 ft. [100m]. (Only 100 ft. [30m] will be covered in every 300 ft. [100m] by the handler's eyes alone.)

35) The dog's POD will run from 5% to 95% at 300 ft. [100m] based on weather conditions.

36) The dog/handler search team then, in a sense, is double coverage and will vary from 21 to 96% POD. NASAR (National Association for Search and Rescue) has used a figure of 50%, which isn't a bad average; but remember it's an average of a wide range. Areas searched morning and evening are much higher than midday *in summer*.

## LOGISTICS

37) Dogs are trained to ride in anything a handler can manage (Search Manager must arrange):

- chairlifts
- helicopters
- slings harness
- pickups
- snow machine sleds
- aircraft
- boats

38) From a practical standpoint, they are limited in steep, rocky, cliff country.

39) Dogs navigate most brush better than most people do.

40) Dogs tire in deep powder snow, but the heavier coated breeds will still search.

41) Dogs require 2 pounds of dog food (dry kibble) each day. The handler will bring some, but on an extended search you should get a 50lb bag of the handler's brand for your teams.

42) Dogs will need at least as much water as the handlers. If there are streams, springs, etc. OK. But in dry country they'll need water rations too. In winter conditions, pack extra water for the dog.

43) Dogs will stay with their handlers at night:

- In a tent.

- In the field.

- In a motel. Handlers will tent rather than leave their dogs, so clear it with the motel. Holiday Inn, Motel 6, and many others normally accept trained dogs.

## MORE ON TRACKING AND TRAILING

44) Two-thirds of scent given off by the subject is heavier than air. It falls to the ground or blows alongside to the ground. These heavier particles form a trail.

45) As the bacteria on the scent particles (skin cells) digest the protein they convert the cells to vapors. The trailing dogs will follow this scent.

46) The longer the bacteria works on the protein, the more it is consumed, until at last, it is all gone.

47) Warm, moist weather causes the fastest rate of conversion, more scent, shorter duration.

48) Very dry weather, hot or cold, gives less scent but sometimes longer duration.

49) A sunbaked particle of protein may have no bacterial action - no scent.

50) After a light rain or morning dew, it may be rejuvenated.

51) When the subject's feet step on vegetation or scuff the dirt, new bacteria is turned up in the soil and cells are crushed in the plants. The cells begin to ferment and the ground smells different. A tracking dog can work these vegetable and soil scents the same as a trailing dog does the human scent particles. Many dogs do both.

52) Some search dogs are cross-trained to air scent, trail and track.

53) Most search dogs will alert to clues as well as people: packs, clothing, etc.

## THE DOG

54) A search dog has 44 times more olfactory sensory cells than a human. He's a super sniffer.

55) A dog's olfactory lobes take up nearly one-eighth of his brain. He's scent smart.

56) A dog can perceive certain smells in the range of one part in ten quadrillion ( $10^{-15}$ ). That's incredible but true.

57) A double-coated dog's coat is good insulation. It keeps him warm in winter, cool in summer.

58) A dog's cooling mechanism is evaporation through tongue and pads.

59) A dog is susceptible to hyperthermia in hot, humid climates. Swimming or dunking helps. *(Or wetting down with bucket or wet towel for short-coated breeds - wetting feet will help too.)*

**THE WEATHER (*also see Weather in Other Sections*)  
AND SCENT TRANSPORT AND DIFFUSION**

60) You can judge the potential convection by measuring your shadow and looking at the sky:

- Nighttime or overcast with low clouds  
= *no convection*
- Daytime and partly low cloudy  
= *low to moderate convection*
- Daytime, clear, or mid to high clouds, over 8.5 [2.6m] foot shadow  
= *moderate convection*
- Daytime, clear, or mid to high clouds, 3.5 [1m] to 8.5 [2.6m] foot shadow = *high convection*
- Daytime, clear, or mid to high clouds, under 3.5 [1m] foot shadow = *very high convection*

61) Wind helps to overcome convection. You'll need a moderate breeze of 13-18 mph [21-29 kph] to overcome very high convection. You will know, if the wind is raising dust and small branches move, that you've got 13 mph [21 kph] or more.

62) Large roll eddies on the lee of ridges and canyon rims cause upslope winds blowing opposite the prevailing wind.

63) Eddies form at bends in canyons and at the mouth of tributaries, bringing scent from different directions.

64) Ridge top saddles and mountain passes increase wind flow. They are a good place to pick up air scents.

65) At edges of meadows, behind hedgerows, at any break in vegetation, expect eddies. Check all the edges, the scent may not be carried away on the breeze.

66) Openings in a forest will heat up and bring a draft into the opening from all directions. Check the middle of openings to take advantage of it.

67) A tree or telephone pole in a field can act like a chimney too. Check around it.

68) Don't expect as much wind in a dense forest as in the open. A 20 mph [32 kph] fresh breeze will be slowed down to 4 mph [6 kph]. A 4mph [6kph] breeze will only be slowed to 2.5 mph [4 kph] though.



69) When the sun is on the slopes of a hill, there will normally be an updraft flow of air. During the day, major canyons will have an upstream breeze. This will carry the updrafts on the slopes diagonally upslope and upstream.

70) The updrafts increase in velocity as they rise. The ridges are receiving scents from off the whole slope.

71) As the side slopes go into shadow, downdrafts begin. It is good to search from the bottom up at this time.

72) Downdrafts are laminar, in thin layers, and flow down like water. Debris piles and brush can act like a dam. Hollows and low shady spots may have scent pooling in them. The mouths of side drainages are good places to check in the shade and at night.

73) Thunderstorm downdrafts push air out in all directions from directly under the cell at the mature stage. A dog can alert from a great distance, so note the location of the thunderhead and the wind direction if the dog alerts.

74) Before reaching a mature stage which has rain, the thunderhead will have a strong convective updraft and will be sucking air toward it. It is important to keep track of what is happening and note the time of the alerts since the wind may be going one way one minute and the other way the next.

75) Smoke candles help you judge what's happening. They are a good tool to use in practice sessions occasionally. One source is Ben Meadows Co., P.O. Box 80549, Atlanta, GA 30366 or P.O. Box 2781, Eugene, OR 97402 (Item 171352).

## MISC

76) There are at least 90 search dog units in the country. They vary in versatility and expertise. Most Bloodhounds don't area search (there are exceptions). A number of air scenting teams don't track or trail, but many do.

77) Search dog teams can reduce manpower needs. One dog/handler team can clear about one half sq mile [1.3 sq km] per day on average, sometimes more. *(Or less in some mountain country.)*

If your primary search area is everything in a three mile radius from the PLS, one dog team will take a couple of months. Better to ask for 20 teams and hope the country isn't worse than average.

Or call 212 grid searchers. The coverage is about the same.

## **SECTION 2**

### ***SEARCH PATTERNS***

#### **Random Search Pattern**

A typical pattern is the dog out ahead of the handler (off leash) and casting back and forth. When working into the wind the pattern will usually be a zig-zag. When working cross wind the dog will be working more so in a straight line perpendicular to the wind. The dog decides the pattern. Terrain and weather conditions will influence the dog's behaviour.

#### **Signalled Search Pattern - guided pattern**

The dog proceeds from the handler at approximately 45 degrees (on a hand signal). The dog will continue in this direction until told to pivot. On signal, the dog will pivot and cross in front of the handler. He will continue until told to again pivot. The pattern will look like a zigzag, but in this case, the outer limits are defined by the handler.

A well-trained dog is usually methodical in his search pattern and will alter his search course as a consequence of wind speed and direction.

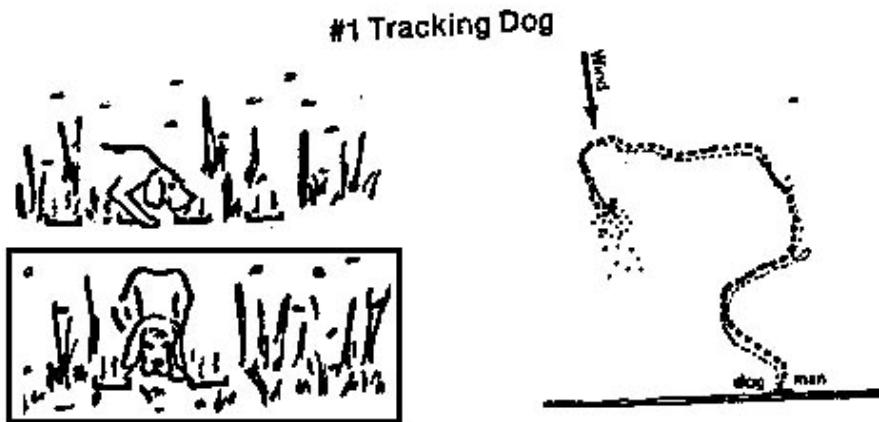
## *GLOSSARY and DEFINITIONS*

*These search dog definitions have been around for 20 years, appearing in the handbook, "Scent and the Scenting Dog" by William Syrotuck, 1972.*

### Tracking Dog

In the strict sense of the term, the dog should indicate almost each of the subject's footsteps. He should not vary more than one or two feet from these footsteps, despite the wind conditions. He is very characteristic in the head down posture, sniffing at the ground for the evidence.

Bloodhounds are the traditional picture of the tracking dog (*1 in 22 make it as a tracking dog*). The basic orientation of the dog is to the footsteps.



## Trailing Dog

This dog is oriented to the rafts, which have fallen to the ground along the person's route. The dog may well by working some distance from the actual footsteps. He will appear to shortcut some corners and overshoot others.

Some dogs will even stop and sniff at leaves of vegetation two or three feet off the ground, and in some cases 30 yards from the actual footsteps. Some dogs will move from the actual steps to an outer boundary of rafts and back again.

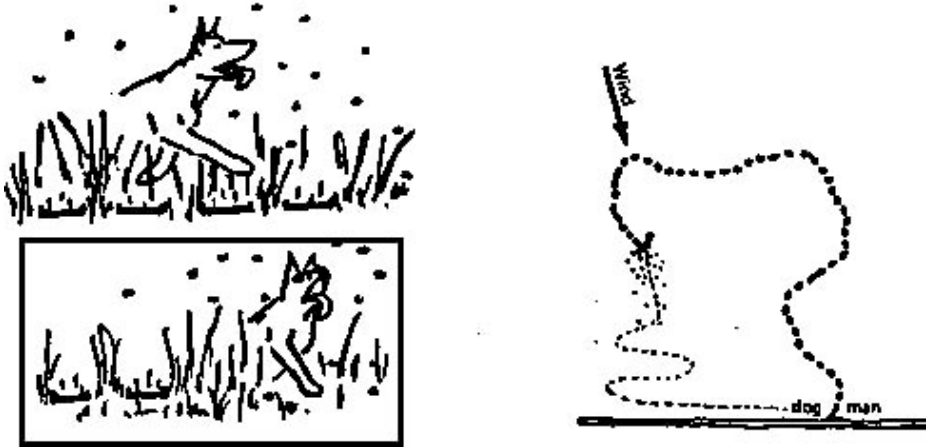


## Air Scent Dog

This dog is usually oriented to the airborne rafts. He is characteristic in that his head is held high, and he usually looks as though searching the air currents for the evidence.

These dogs may completely ignore the ground deposits or move in on an airborne scent from the track. (*Usually the nose is where the scent is.*)

#3 Air Scenting Dog (Searching)



Air Scent dogs are also referred to as “Point Source” oriented dogs. They fall into several categories:

### Single Element

Specific drug and bomb detecting dogs fall into this category.

### Human Detecting

These dogs are cued to *any* human being. Avalanche and rescue dogs are examples. These dogs detect the presence of a human being in a particular environment, whether it be snow or debris.

### Human Discriminating

These dogs are oriented to a particular person via a cue, such as an article of clothing.

This dog is seldom ground oriented and is cognizant that the source may be anywhere above or below ground level.

The basis of training is to follow the increasing level of odor intensity until the dog has “homed in” on the source.

This type of dog has the highest discriminatory potential as he must constantly discriminate the cue odor from the surrounding environment and then determine its point of strongest concentration.

Their one limitation is that they are not particularly ground oriented for precise tracking, but they can and do trail when this has been included as part of their training.

## Scent

All those combinations of odors or smells that characterize an individual.

The main ingredients of human scent are the bacteria acting upon the dead cells in the environment of the skin secretions. Bacteria break down the cell components and secretions, such as protein, into amino acids. The amino acids, in turn, are broken down into such chemicals as ammonia, methane and hydrogen sulfide.

The resultant by-products have characteristic odors that are probably a mixture of vapours and gases. Such bacterial action is a fundamental of scent. Raft, carrying bacteria and body secretions enshrouded by the resultant vapour make up scent.

### Discrimination

The dog does not recognize the scent of an individual because of the presence of some one, single chemical substance peculiar to that person, but rather because of a pattern or complex to which substances may contribute even if they are present in sub-threshold amounts (Neuhaus).

This scent pattern becomes the scent "fingerprint" unique to each person by which dogs discriminate among different people.

## Scent Plumes *(also see 77 Facts #28)*

Typical Sequence:

Night - clear calm	fanning
Sunrise + 1/2 hour	fumigating
Daytime	looping
Sundown	lofting

## Odor

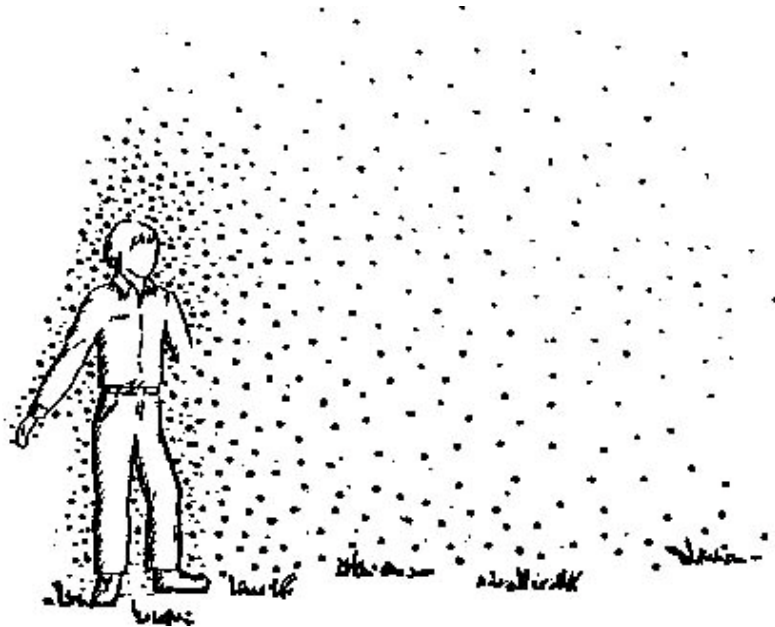
Specific: chemical, axilla (odor), foot (odor), etc.

## Rafts

Dead skin cells, averaging 14 microns (.014mm) in size, shed at the rate of 40,000 per minute.

Rafts don't necessarily fall to the ground from the body. Studies have shown that a current of air exists next to the skin surface, the estimated speed of which is 125 feet [38m] per minute. It begins at the feet, travels up the legs, slows down under the arms, eddies under the chin, speeds up following the contours of the face, and then takes off like a plume from the top of the head.

The final dispersion is about 1.52 feet [46cm] above the person's head. The velocity increases as the outside temperature decreases.





## Airborne Scent

Raft, with its vapour cloud, travelling in air currents or thermal layers.

## Ground Scent

Scent produced by both the Rafts that fall to the ground and the related crushing of vegetation.

## Ground Scent Picture

Two types: Vegetated and Non-Vegetated area

### Vegetated area

The combination of airborne rafts coming to rest on the ground and the physical disturbance of the earth as a result of a person's footsteps.

A footstep on a soil surface can produce two results: a physical disturbance of the soil, and the crushing of associated plant life.

Disturbance of soil surfaces releases moisture and chemical vapours of soil ingredients. As well, there is soil bacteria, responsible for the breakdown of plant and animal materials.

Bacteria is dependent on such factors as environmental conditions, favourable moisture, hydrogen ion concentration, temperature and available food supply. The crushed vegetation provides the nutrient for the soil bacteria. The resultant by-products contain many odorous compounds.

The number of plant cells killed in the area on one footstep can be quite large, and each footstep becomes shrouded in a vapour (or gas). This vapour, with its different constituents, has an intensity different from, and stronger than, the surroundings.

Some of the chemicals liberated by the decomposition of plant and animal matter by soil bacteria are: nitrates, phosphates, nitrites, ammonia, carbon dioxide, sodium chloride, etc.

Temperature, humidity and pressure change from hour to hour - and they influence the continuity of vapour produced by the bacteria.

Rafts on the ground will continue to give off a vapour until the food source is depleted, if temperature and humidity are favourable. Humidity is vital to bacteria. Sunlight seriously affects the bacteria, as ultra-violet, violet and blue rays are bactericidal.

In summary, there are vegetative fluids, vegetative odors, and human scent - and a combination.

The vegetative fluids are released from crushed vegetation and injured plant life. It is perceptible almost immediately and dissipates rapidly, since it is mostly vapourous. The vegetative odors are a result of soil bacteria activity on dead plant cells, releasing vapours for a much longer time.

Human scent is the vapour-enshrouded raft coming to rest on the ground. It continues to release vapours due to bacterial activity.

Since the process has already started when leaving the body, the duration of vapour release will be shorter as compared to the vegetative odors. As well, the number of human cells that serve as nutrient are far fewer as compared to the number of dead plant cells killed in one footstep. It would be expected that the intensity level would be lower, giving us a shorter, lower level process.

Therefore, under optimum temperature and humidity, there is an intense fluid odor for a short period of time, usually less than a half hour, stronger human scent than vegetative odor for the first two hours, and then a much stronger vegetative odor than human scent for about the next sixteen hours, after which the human scent is almost non-existent and the vegetative odor is weak but continuing (*generally speaking*).

The intensity of vegetative vapour can also be related to the weight of the individual and the size of his footstep.

#### Non-Vegetated area

Hard surfaces (rock, concrete, etc.) do not readily support bacterial growth or physical disturbance or vegetation effect.

As a person passes over the surface, the rafts are still deposited, but their pattern is diffused as there is little or no surface features to trap them. Raft life is rather short. When the surface is hot and dry, they may even have lost their vapour cloud before they reach the surface.

However, because the basic ingredients (cells, chemicals, bacteria) are still present, a small amount of moisture (dew, mist) can rehydrate the raft and start the bacterial process working again.

Rafts exposed to direct sunlight will probably have their resident bacteria killed, but those that fall into cracks or crevices may rehydrate at dark, dehydrate in the heat of the day, and rehydrate again. This may go on for a definite period of time, until the process has gone to completion.

The decay rate will be relative to temperature and humidity.

Some broken, uneven or porous surfaces will support microbial life a little longer than others, such as, sandstone, rock slides, coarse asphalt.

## Evidence

Two types: Discriminatory and Non-Discriminatory

### Discriminatory

In relation to the total ground picture, the humanoid evidences are the raft vapours. Some rafts may fall very close to the footstep, but the majority will be dispersed over a wide area, depending on the wind.

If a person walks at a rate of three miles an hour, there will be approximately 151 rafts per foot deposited along his route. These rafts are extremely small, thus the vapour is not long-lasting and may go through different intensity levels.

However, these rafts, only a few of which fall near the footsteps, are the evidences and provide the information for discriminating one human from another.

### Non-Discriminatory

In relation to the total ground picture, the second evidence along one's route is the dead plant vapours. They originate in the area of the footprint. This does *not* provide the dog with the necessary information to discriminate one human from another. Depending on the training, it only provides him with the information that "someone" has passed over a relatively undisturbed vegetated area.

Furthermore, after the raft vapour has diminished but the plant vapour still exists, a tracking dog *cannot* differentiate between footsteps made by a human or a piece of wood.

The dog is able to perceive differences in intensity (strong, stronger or strongest). Differences in intensity can be differences in "time" at which the footsteps are made. For example, if a dog is following one set of footsteps (raft vapour has diminished) that is three hours old, he can recognize another set of footsteps one to two hours old that crossed the first. In essence, there was a difference in intensity (or time).

However the dog may have a great deal of trouble telling the difference between two sets of footprints that crossed each other if they were made at the same time and by persons of about the same weight and shoe size. There is, of course, the question of three hour old footsteps of a 200 pound man and two hour old footsteps of a 100 pound man. Discrimination will be relative to training.

It is important to note that a dog may “appear” to be following footsteps which are associated with a particular person, when in fact he is following the dead plant vapour which provides him with no information for humanoid differentiation. This performance is relative to training.

## Dehydration and Rehydration of Rafts on the Ground

For bacterial activity to continue, a certain amount of moisture must be present. Very hot and dry atmospheres dry up the nutrients (rafts, plant cells) of the bacteria to the point where activity will cease. Bearing this in mind, consider variations in humidity.

Rafts *deposited in the early afternoon* of a hot day will start drying up. Bacterial activity will go into the process of diminishing. However, during the early evening, dew forms on the blades of grass. This rehydrates the cells, and the few remaining bacteria once again have their food supply.

The bacteria multiply rapidly and the total process is reactivated, most likely giving off a higher vapour intensity than when the rafts were originally dropped to the ground.

If one views this over a specific time span, one would see the following process: when first dropped, the vapour intensity would be moderate. In the afternoon the level would start to diminish. In the early evening (with dew and lower temperature) the level would pick up. By late evening the level would be quite high.

This would indicate that even though the rafts were deposited around noon, the chances of perceiving them would be best that evening.

On the other hand, rafts *deposited in the evening* have their process slowed down during the night. The following morning they are rehydrated from the dew and the process is accelerated as the temperature approaches optimum conditions. Thus they are more easily perceived in the morning.

## Foliage

Vegetation provides shade and moisture to the bacterial activity of the rafts and dead plant cells. We can also have variations due to the shading effect of broad leaf plants. For example, rafts of a footstep may become exposed to direct sunlight, killing a certain percentage of bacteria. As the sun moves, the bacteria become shaded again, increasing their activity. As a consequence, the activity may have been at a high level, become lowered, and then reactivated to a high level.

## SECTION 3

### *SCENT DIFFUSION*

*(also see Weather)*

The transport of scent through the air is essential in air scenting. As scent diffuses with distance from the source, it mixes with intervening air until it becomes so diluted that the dog can no longer detect it.

Scent diffusion is affected by: *vertical mixing* from convectional turbulence, eddying, and plume rise from convective lift; *lateral mixing* and spread from changing wind direction and gustiness; *removal processes* such as sedimentation (fallout), washout (rain, snow), sinks, and absorption by vegetation.

Dog handlers need to recognize atmospheric conditions that lead to diffusion so that they can judge the ease or difficulty for their dog and adjust their search patterns accordingly (Also get weather report from management team).

### Convectional Turbulence

That part of the atmosphere located at the surface consists of a boundary layer that varies in depth according to meteorological conditions. The depth or height if this layer is referred to as the “mixing height”. The Weather office can supply the height of the mixing layer. The greater the height, the greater the volume of air available for mixing and the more quickly scent diffuses.

Wind velocity and temperature gradient through the boundary layer influence turbulence.

Temperature gradient determines air stability. Unstable air creates more looping, making the search dog’s job harder.

Since surface wind speed tends to overcome convective rise, higher wind speeds depress vertical mixing. Cloud cover and height plus sun angle also greatly affect air stability.

*Summarized by the Editor as follows:*

*Optimum scent concentration is at night with little or no wind and mostly clear sky (less than 50% low to medium clouds).*

*Less optimum for night is stronger wind and/or more cloud cover.*

*About the same is early morning or late afternoon but with the wind having less of an effect.*

*Around noon is the worst time, stronger winds are good, and a clear sky is worse than a cloudy sky.*

Now we see why dogs have good days and bad days!

It may be seen that on clear summer days with little wind, when the sun is more directly overhead, the air is highly unstable and scent will diffuse most rapidly. Sectors searched under these conditions should be re-checked under better conditions. During June, July and August, search early and late and give the dog a break at midday.

## Eddying

Surface variations - hills, ridgelines, treelines, buildings - cause mechanical disturbance. Scent locked in turbulent suspension diffuses according to wind speed and direction of flow.

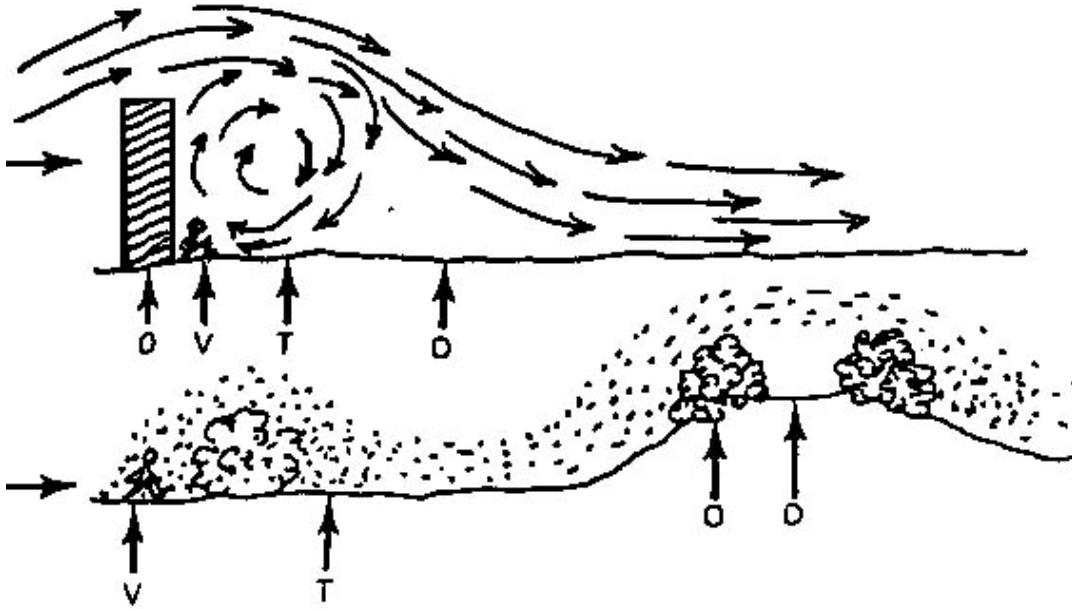
Wind speed and direction are quite variable over a mountainside from ridgecrest to canyon floor.

Terrain obstacles exert drag forces that disturb the smooth flow of free air. Therefore, flow over mountain terrain is relatively irregular.

Generally, higher winds with higher accelerations and decelerations increase scent diffusion.

## Plume Rise from Convective Lift

*Illustration from Scent and the Scenting Dog, by William Syrotuck, Pg76*

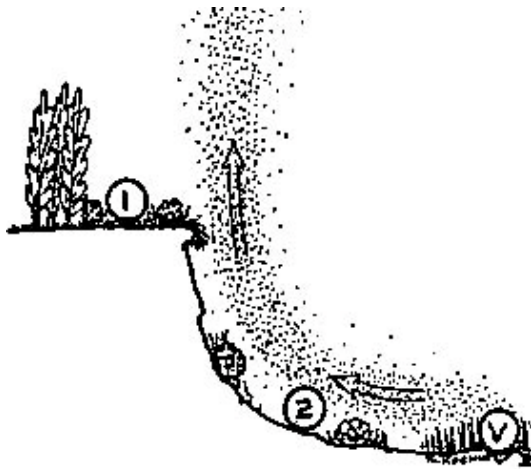
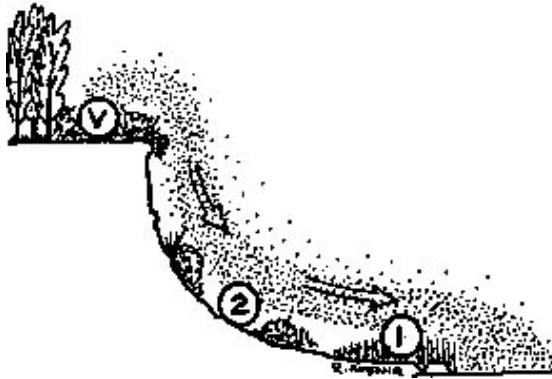


- O - obstruction of a dense nature
- T - areas of turbulence
- D - dead areas with little air
- W - wind in excess of 5 mph
- V - victim



*Illustration from Scent and the Scenting Dog, by William Syrotuck, Pg47*





*From a paper, Wilderness Search Strategy for Dog Handlers by Marcia Koenig for NASAR. Illustrations by Bob Koenig*

On a still day with stable air conditions, the scent plume will be affected by the ambient air temperature. If the air is cooler than the scent particles and gases released by the victim, convection lifts the scent cone several feet as the scent releases heat until it reaches ambient air temperature. Losing its columnar shape, the scent cone fans out and hangs above the ground.

On very warm days (above 85°F/29°C) with cloud cover (stable air), the scent does not rise. Scent fans out at ground level. Temperature inversion, as in a mountain canyon, will also hold scent down low.

Atmospheric stability is an important variable at all times, but the heat release rate may be important on clear, cold nights or days, especially with little wind.

Winds tend to push and bend or shear the column and restrict the total possible plume rise. Strong winds may push the column nearly horizontally until all of the heat is released and no more convective lift occurs.

## Deposition of Airborne Scent Material

Scent composition includes solid particles large enough to precipitate and gases that may be absorbed into vegetation and other surfaces.

Airborne scent may deposit on the ground by: particle precipitation, impaction and absorption at the ground surface, subsequent downward turbulent flow into a *sink*, and rain or snow. All three mechanisms deplete the plume of airborne scent.

But the resulting ground surface contamination, especially if precipitation increases scent concentration close to the source, can aid the search dog team trying to find the source.

## Scent diffuses in water

The trained search dog can scent a human body or other chemicals submerged in water once the molecules in question reach his nose. The laws of physics hold here too. The difficulty lies in predicting what will happen physically.

Scent diffusion through, and atmospheric release from, water is a function of many variables including:

- rate of fluid flow
- direction of fluid flow
- fluid composition and temperature
- solubility of subject chemicals in fluid
- ambient temperature
- wind speed

The handler whose search dog alerts into shallow riffles downstream of a turbulent falls may logically expect that a body is being held down by eddies at the base of the falls and may request divers to explore the pools there.

If a search dog alerts out of the prow of a boat or starts swimming in circles over one spot in a calm lake, the handler will logically ask the divers to begin searching down at that point.

*The state of a scent source affects scent diffusion and detectability.* Because heat increases molecular activity, scent diffuses faster from a hot body than a cold one.

However, even a human body that is frozen emits some scent. Because of increased convection currents, warm bodies in a cool environment will give off proportionally greater scent than cold bodies in the same cool environment.

Dogs are, therefore, an effective search tool at night where moisture increases molecular action and where the temperature gradient between the person's body and the atmosphere is larger than during the day.

Other scent source states affecting diffusion include:

- "Air tight" containers. Few containers, even spaceships, are perfectly air tight. Keep in mind the Yellowstone grizzlies who can smell through tin can seals.
- Aging and drying causing decreased diffusion.
- Chemical changes from molecular action that causes heating and increases the diffusion rate (putrefaction, burning).

## *DETECTION*

The search dog's ability to find people and things depend on *all* of his operant senses - smell, taste, hearing, vision and touch - as well as on something called his "labile mind", that is, his natural disinclination to focus attention steadily on one task.

## The Dog's Senses

**Ears:** The upper frequency limit is thought to be twice that of man. In terms of sensitivity (the least loud sound perceivable at a given frequency) dogs and man are about equal at low frequency, but dogs appear markedly superior at frequencies between 1000 and 8000 cps.

Moving helps the dog locate sound and its direction.

**Eyes:** Dogs see well at night. Incident light is reflected back onto the receptors, doubling the stimulation factor.

What light is not absorbed by the retina passes out through the transparent tissues forward through the pupil and out of the eye. This reflected light is the familiar "eye shine" when eyes of predatory carnivores glow at night when light is shone on them.

The larger areas of binocular vision, coupled with depth perception and judgement of position, in the dog and cat is responsible for their ability to leap on fast-moving prey accurately.

**Paws and Whiskers:** Dogs have tactile senses. Touch is an important recognition mechanism in physical encounters. The dog exhibits a low, medium or high pain threshold through his tactile sense.

The dog uses touch while searching, pawing at debris while alerting to a find, whiskering minute quantities of evidence (presumably to further define its shape and substance).

**Nose and Mouth:** The olfactory system consists of paired nostrils, nasal chambers, the receptor cells found in specialized epithelium (which lines portions of the cavities), olfactory nerves, and olfactory lobes in the brain. The nasal chambers of the dogs are relatively larger and much more complex than those of humans.

They are lined, in part, by odor-detecting cells from which nerves convey sensory information to the relatively large olfactory lobes of the brain.

The olfactory areas in keen-scented animals have increased through evolution by a lengthening of the nose and a folding of the nasal bones, thus increasing the sensory surface. The epithelial lining of the nasal chambers, being richly supplied with blood, functions as a respiratory surface (secondary to the lungs). The respiratory epithelium is present in a proportionately larger extent than is the olfactory epithelium to provide greater filtration and warming of inspired air.

The total surface area of the olfactory lining is enormous and may often exceed that of the entire body surface.

A bony shelf in the nasal chambers forces inspired air onto the olfactory epithelium. Because of the complex recesses in the nasal chambers, all of the air does not get washed out upon expiration; instead, the recesses permit the accumulation of odor molecules which may be unrecognizable in a single sniff.

## Threshold of Perception and Recognition

Dogs are from one million to one hundred million times more sensitive than man to the scents of common body acids. The dog, like man, shows nose fatigue when exposed to high concentrations of scent for more than a short time.

The dog also has a threshold of *perception* which is lower than its threshold of *recognition*.

If conditions were favourable, a trained dog should be able to follow a trail as much as 24 hours old (*some longer*).

## *INTERFERENCE*

Some scents interfere with others in the dog's nose.

Highly volatile substances, like gasoline, can diffuse rapidly and saturate the nasal passages so that the dog's scenting capability is inhibited for minutes or possible hours.

We may assume that carbon monoxide, combining with blood hemoglobin, depresses scenting. Drugs that depress scenting ability in dogs include atropine, urinary tract drugs, antispasmodics (for diarrhea), anesthetics, antihistamines, and belladonna (Donnatol).

Apparently digitalis, thyroid, and derivatives have no effect. Alcohol also depresses olfaction. Caffeine and amphetamines stimulate the dog's scenting capabilities, but is not known for how long.

## ***DISCRIMINATE OR DETECT?***

How much time has elapsed? Is the problem associated with place or environment?

If police want to search a building (place) then searching for *someone* in the building will do (detection). The same with an avalanche or disaster.

In a wilderness area we can have a dog methodically search an area where there are no other people. The dog only has to find *someone*, the lost person (detection).

Discrimination (cueing to a scent article, that is, the scent of a specific person) is usually used when several scents are in the area, whether trailing or air scenting.

Discrimination is usually required in police work (scene of the crime). The dog must distinguish between the criminal and non-criminal, provided some cue is presented. For discrimination the dog must be entirely raft oriented as that is where the human discriminatory evidence lies.

If the discrimination method is used in a wilderness area, and if we use tracking, then the following conditions must be met:

- early dispatch to the scene (time)
- conducive atmospheric conditions (environment)
- available article of clothing (cue)

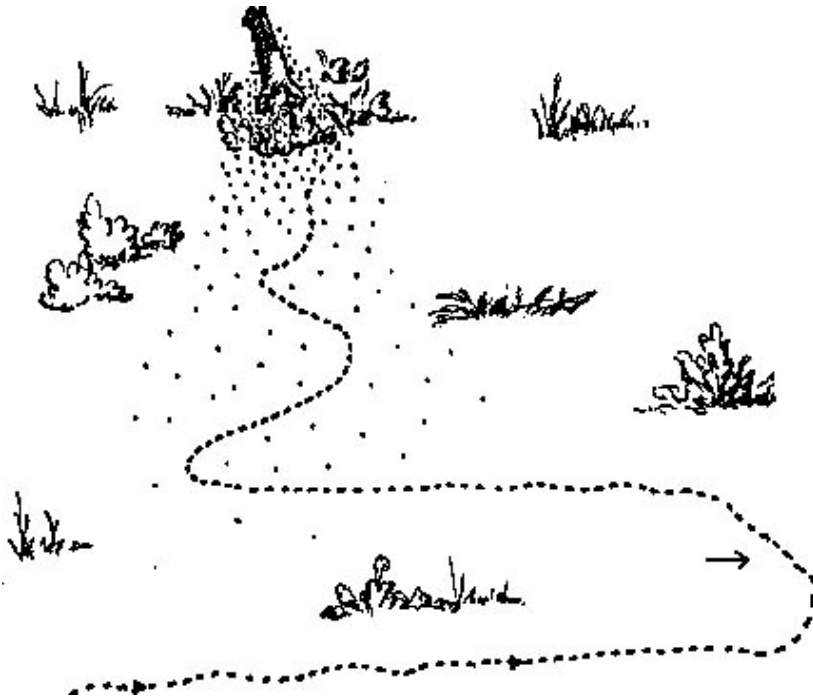
For a detection dog none of the above apply. The victim is the source of scent and will be emitting it for a long period of time; even a dead body emits scent. Thus the search dog is not limited to time. Heavy rain will wash out tracks but does not stop the source from emitting scent. Thus the dog is not limited by conditions. An article is not required, as the dog will detect any human being in the search path.

**In Summary:**

It is necessary to define the problem to be performed (discrimination or detection). It is necessary to apply the correctly trained dog to the appropriate task.

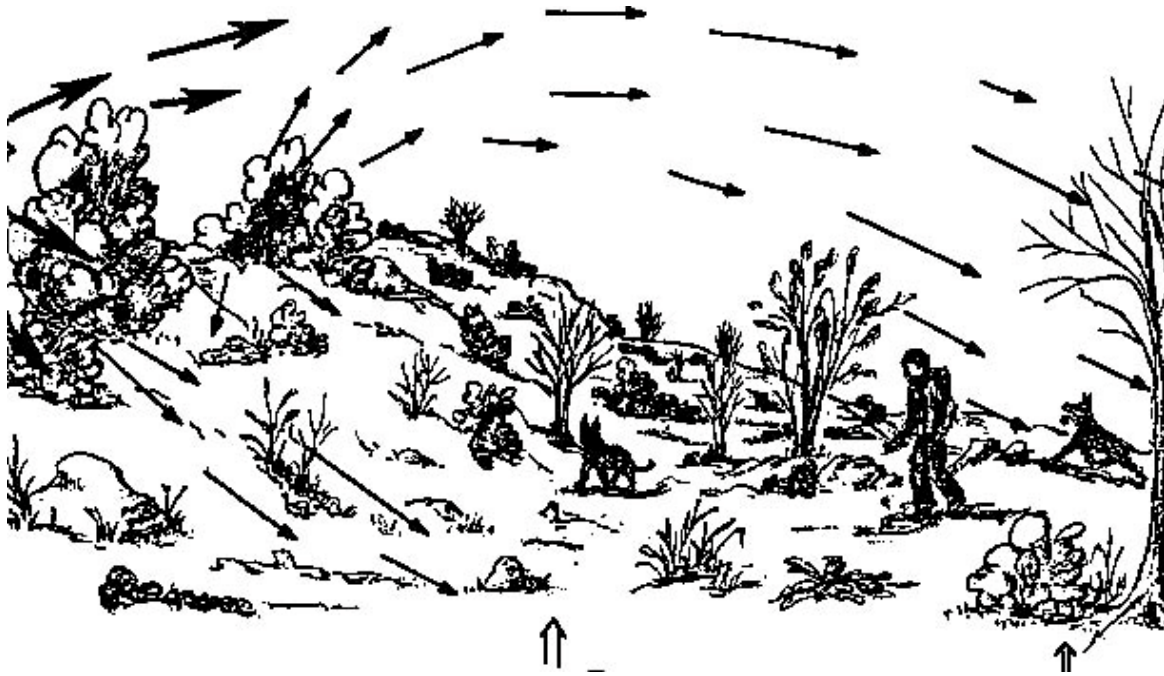
## *TRACK OR AIR SCENT*

Why train tracking separately from air scenting? Because the handler must at times be able to command his dog to *Track* a specific ground picture. At other times he must be able to command his dog to *Find* by searching for air scent and ignoring the ground picture. Frequently, he will want his dog to do either, depending upon the scent information available to the dog.



*Illustration from an Untitled work, 33 pages, 1972, by William Syrotuck*





*Illustration from an Untitled work, 33 pages, 1972, by William Syrotuck*

## ***WEATHER***

*(also see Scent Diffusion)*

Weather tends to disintegrate track. Wind acts not only to blow scent away, removing gases and particles that identify the track to the dog, but also to aerate, dry out, and reduce bacterial activity. While low to moderate wind conditions are an asset for air scent search, the less wind the better is the rule for tracking.

High humidity favors tracking and humid conditions combined with high temperatures encourage discrimination in the tracking dog for a significant time after the track is laid. Light rain freshens track scent; however, pouring rain or heavy snow disintegrates the track. The sun can literally “burn out” a track. Direct sunlight kills bacteria and also generates locally high temperatures that dry out and destroy scent-producing reactions. The best tracking conditions usually occur in the early morning or evening (and at night, but the handler is slower) on north-facing slopes (Northern Hemisphere) across low, damp grasses.

## ***SPECIAL CONSIDERATIONS***

Don't be concerned about whether the dog has been trained on or off leash. There are two schools of thought here. The preferred method is off leash for air scent or trailing. *Is the dog obedient?*

Be cautious of purely vegetative vapour trained dogs.

Be aware that dogs practice association. If a dog associates footsteps as being the cue for a victim, he may miss the victim because the footsteps don't lead right to the person.

## ***PICKING A DOG HANDLER***

Ask the handler how long he/she has been training the dog for search work. What is the dog trained for - track, trail, air scent, water, disaster, avalanche, etc. (Even if the dog can do excellent field track, it does not mean it is trained for search work.)

The handler should be trained in searching, not just dog handling. The handler should show up at the search site with equipment for himself and the dog.

If a backup person goes out with the handler and dog, they should not wear a cologne or perfume, nor should smoking be permitted near the dog.

Note the handlers transport area for the dog. If the dog rides in the car with the handler there should be no air fresheners, as these will affect the dog's sense of smell.

Does the handler let the dog out to socialize with people in the base camp before the search? *Some dogs need to be socialized after a long trip. It gives them a chance to relieve themselves and stretch their legs.* Generally, the dog should be kept away from people until it is needed for the task, as it will be more eager to work and properly rested. After each assignment the handler should attend to the dog's needs before his own. Then put the dog back in his quiet area.

Handler should not be reluctant to allow the search manager or backup person to meet the dog. Take note of the dog's temperament. It should have a reasonably friendly personality.

A medium to large size dog can handle rough terrain better, and has better endurance.

Check whether the handler uses a collar or harness on the dog. If either is used, it should be the harness.

If handler and dog are to be transported in a SAR vehicle, the handler should ask questions about smoking on board, other people wearing colognes, or whether the vehicle was/is used to transport fuel.

A handler should have a good knowledge of how weather and terrain can affect a track, and be able to explain this to the search manager for planning.

Most search dogs work from a scent article, which the handler usually likes to get to prevent scent contamination. If, however, it is beneficial to have someone else pick up the article, the search manager must know how and what to collect.

Does the dog bark? How does it alert?

Don't be too quick to pass critical judgement on the dog if he does not appear to be working properly. The dog can only work a scent if it is there.

Invite the dog handler into the search planning session.

## ***WHY USE A SEARCH DOG TEAM?***

A qualified Search Dog team could work a search over 24 hours old by trailing or air scenting, given the right conditions.

An air scenting dog can alert on the victim's scent - dead or alive, because the victim is still emitting., if in the right general area.

A searcher has a greater chance of missing evidence (scent/odor) or victim.

## ***HANDLING EVIDENCE OR SCENT ARTICLE***

A scent article belonging to the victim can be invaluable to the search dog team. The article should have a strong and recent scent (use) - such as, pillow case, PJ's, T-shirt, toque, hat, etc.

Have a pick up person get scent articles.

Use tongs, if available, to put scent article in bag.

Use inverted bag otherwise.

Check if the scent article has been contaminated by contact with other strong scent articles.

Don't allow other people to handle or "prepare" articles for the pick up person.

Make sure someone is home - for pick up.

For scent articles, some handlers prefer plastic freezer or Ziploc bags, others prefer plain brown paper bags. It is up to the handler.

## ***THE SEARCH AND RESCUE DOG***

### **OBEDIENCE**

Search and rescue dogs are obedient dogs, under control at all times. The successful dog/handler team must complete the following exercises individually and together with other teams whereby only hand signals are used.

1. Heel, jog at heel, sit and down at heel.
2. Stay, master out of sight for 5 minutes.
3. Recall from a distance of 15 meters.
4. Stay or down on recall.
5. Sit at a distance of 10 meters.
6. Down at a distance of 10 meters.
7. Finish at heel position.

### **AGILITY**

This profile is an extension of obedience. It also develops the dog physically, preparing it to deal with strenuous tasks encountered in rescue operations.

The agility course consists of a number of jumps one meter high, a window jump, a vertical wall, suspension plank, balance beam, a culvert, and an "A" frame ramp. The dog must successfully negotiate all of these hurdles off leash with the handler at a moderate jog. The dog is under control at all times at the handler's left side.

### **TRACKING**

The purpose of this profile is to provide a qualified tracking dog to assist police in finding missing persons and possible evidence.

Dogs are trained to follow a track of human scent and crushed vegetation using their magnificent nose. The dog's nose is far superior to man's. The total number of olfactory cells in a human is about 5 million. The dog has 125 - 200 million. Its sensitivity is amazing. The dog can detect some odors at as little as one part in a trillion.

A greater proportion of the dog's brain is devoted to the sense of smell, unlike in humans whose size of the olfactory area has decreased and the thinking part has increased. For this reason, when training, BELIEVE YOUR DOG as he is the best judge of what he smells!

The necessary equipment for the tracking dog consists of a non-restrictive harness and a 20 - 25 foot long line, preferably made of leather. The dog is trained to follow a single human scent, disregarding all else. The successful candidate must complete a 45 minute old track set by one person in a rural environment. The track includes:

1. 2 road crossings
2. 3 scent related articles
3. the dog must indicate right and left 45° turns
4. 1 dead end
5. cross tracks - human
6. 20 meters on low scent area such as gravel
7. animal scent distraction

## RETRIEVING

The SAR dog must retrieve articles found on a track belonging to the person the dog is to find. The dog should be taught to retrieve a variety of articles including those made of leather, wood, cloth, as well as glass and metal objects.

For certification purposes the dog must sit at handler's side, stay while the dumbbell (wooden) is thrown 10 meters. On the "fetch" command, the dog must pick up the object, return to the handler, sit in front position and hold the article for 30 seconds. On command "out" the dog gives up the article and goes to the heel position, again on command.

## SEARCHING

Searching involves air scenting to locate a missing person. This is opposed to tracking where the dog's head is low, near the ground, following the scent left by a person's footprints. The handler must pay close attention to wind direction when searching. Scent from a lost person or article will be carried to the dog by the wind. Therefore, it is beneficial for the dog/handler team to work into the wind.



**Testing in this profile involves:**

- 1. A search for a concealed person in a rural environment. The search includes bush and open terrain approximately 400 meters by 400 meters. The search is to be completed within 20 minutes.**
- 2. A search for 2 medium sized, well scented articles in a rural area. Articles are concealed about 24 hours before the start of the search. The search area is approximately 200 meters by 200 meters. The 2 articles are to be located within 20 minutes. Hand signals and voice commands are used to direct the dog.**

## INDEX