THE EFFICIENCY OF COMPANION RESCUERS WITH MINIMAL TRAINING

Manuel Genswein, Meilen, Switzerland
Ragnhild Eide, Koppang, Norway

ABSTRACT: Whereas the theoretical efficiency of companion rescue is never questioned, serious doubts are expressed when it comes to the reality of survival chances.

In a field experiment including 30 novice companion rescuers, the potential level of efficiency was determined during three days with various rescue scenarios. The rescuers were trained in three 45 min. practical workshops (single and multiple burial search, probing, excavation and triage).

The rescue scenarios were set up as realistically as possible using life sized buried objects in hard debris. The complexity of the rescue scenarios varied between the number of buried subjects, their depth and proximity to each other, the number of rescuers, and size of the debris field.

The target of the experiment is to show what efficiency companion rescue can provide if the instruction, the rescue systems as well as the rescue equipment is optimized for novice companion rescues.

Data collected in the field included, 1) times for coordination, 2) times for each individual phase of the search process (Signal, Coarse, Fine & Pinpoint), 3) triage measures, 4) as well as the different stages of excavation, plus 5) photos and video documentation.

Results show that companion rescue is very efficient and residual survival chances are surprisingly high even in multiple burial situations.

KEYWORDS: Companion Rescue, Avalanche Rescue, Search Systems, Avalanche Rescue Technology, Rescue Training

Corresponding Author address:

Manuel Genswein
General Willestr. 375
CH – 8706 Meilen
Switzerland
Phone: +41 79 236 36 76
E-Mail: manuel@genswein.com
Internet: www. genswein.com

Ragnhild Eide
Trønnes
NO- 2480 Koppang
Norway
Phone: +47 90 154006
E- Mail: ragnhild.eide@naturopplevingar.no

1. INTRODUCTION

Although the theoretical efficiency of companion rescue is never questioned, serious doubts are often expressed when it comes to the real efficiency and survival chances in multiple burial situations. The current accident databases show today's organized and companion rescue efficiency is heavily influenced by sub-optimal factors. The complexity of the rescue scenario may be influenced by prevention measures and means of survival. The efficiency of the rescue mission may be influenced by the choice of adequate rescue equipment, effective search and rescue strategies including effective teaching methods.

Certain variables of a rescue mission are hard to influence, others could be easily optimized without having to invest more time or financial resources than is already performed today. This is particularly true when it comes to the training of the rescuers.

2. GOAL OF THE FIELD TEST

The goal of the field test is to show how efficient companion rescue can be with companion rescuers and minimal training. The setting is optimized on purpose: Rescuers are equipped with what we believe is the most appropriate rescue equipment today and participants are taught "best practice" search and rescue methods in a manner that is pedagogically and didactically optimal.

Only existing equipment, search and rescue systems, and teaching methods have been used. None of the systems or equipment are particularly complex, time-consuming or expensive. The field test only shows how efficient the different existing tools and systems can be applied.

2.1 Definition of terms

Signal Search — the search process with a search device until the first signal from the buried subject can be received.

Coarse Search — the search process from the first point of reception until the signal decreases for the first time as the rescuer has walked over the buried subject.

Fine Search — the search process within the last few meters until a clear minimum of distance or maximum of volume can be isolated by applying a grid search in an orthogonal coordinate pattern.

Pinpoint Search — the search with the probe pole until the rescuer hits the buried subject.

2.2 Test participants

The 30 participants where provided by the BA Physical Education and Outdoor Life Program of Volda University College, Norway.

Their preexistent knowledge consisted of a one week ski touring course and ski touring experience from private activities. Looking at companion rescue, previous knowledge was at the beginners' level with little to no prior experience. Based on their very basic experience level, relatively little time was needed to make the participants adapt to the systems taught in the practical training modules.

3. TEST ENVIRONMENT

A site near the field laboratory of the Norwegian Geotechnical Institute in Western Norway was chosen as the test site. A spring snowpack with high density and hardness was determined to be a realistic simulation of dense avalanche debris.

3.1 Test fields

Test fields were either 50m X 80m (=median size of "survived recreational avalanches" in Switzerland) or 80m X 120m (=median size of "deadly recreational avalanches" in Switzerland).

Slope inclination was between 5° — 15° in the low angled fields and between 15° — 25° in the steep fields.

Starting point for all rescuers was always in the center bottom of the field. Assuming that about 50% of the rescuers in a companion rescue setting will access the field from the top and 50% from the bottom the times indicated are skewed on the long side because half the rescuers were approaching from the bottom, and this position causes movement to be slower. In reality a companion rescue may be conducted primarily from the top, which would yield faster rescue times. Foot penetration was around 5-20 cm. Most companion rescuers chose to conduct the rescue effort without skis.

All 15 fields were completely tracked up so that the position of the buried subjects could not be guessed.

3.2 Buried subjects

The “victims” were two bags normally used to carry firewood, sewn together and filled with straw. The texture of those bags closely resembled the stickiness of ski clothing to snow, therefore making it necessary for the rescuers to completely remove all snow before being able to transport the victims. In order to avoid a loosening of the debris around the victims, great care was taken to dig small shafts during burial. In addition, the snow around the victims was left to re-freeze on the surface for one night. The next day the snow around the victims was stomped down layer by layer. The second day after the “victims” were buried they were ready to be rescued.

3.3 Test procedure and data recording

Out of the group of 30 companion rescuers, the number needed for each subsequent test was chosen in a randomized pattern. The amount of rescuers varied between one and six. Participants only knew a few minutes before the test started who they would work with during the rescue mission. Finally, the setting of the accident was explained to the rescuers.

Time measurements began when the test site leader gave the signal “start”, after the scenario has been presented to the group.

Recorded were:

- Time until the rescuers started searching (organizational time)
- Signal search time
- Coarse search time
- Fine search time
- Pinpoint time (probing)
- First visual contact with the buried subject
- Head access time
- Full body free
- Body on the surface

Documentation included high-definition pictures as well as real-time video. An instructional video will be available.

4. PRACTICAL TRAINING MODULES

All participants started with three practical training modules of 45 minutes with the following content:

Module 1: Handling equipment & single burial search.

This module started with the general handling of the personal rescue equipment like turning an avalanche transceiver from transmit to receive and deploying a probe and shovel.

The first searches where taught in single burial situations applying the “airport approach” (1) teaching method followed by the fine search and the pinpoint search with the probe pole (2)

Module 2: Multiple burials

In this module the participants learned how to apply the search strategies for multiple burials far apart and in close proximity to each other. Participants learned how to solve multiple burial scenarios by applying the device specific “marking” features as well as the device independent search strategy “micro search strips” (3, 4).

Module 3: Excavation

How to efficiently excavate a buried subject was taught in this third module. The V-shaped snow conveyor belt (5) method was taught for this lesson.

After teaching these three modules, participants learned the recording methods in two different avalanche rescue exercises in order to make sure that the scenarios will be properly recorded.

These preparation exercises were followed by two quick lessons of 15 minutes each: How to efficiently chop blocks with the avalanche shovel and remote reverse triage criteria.

4.1 Organizational and logistical aspects in survival change optimized avalanche rescue procedures

Compared to summer mountain rescue, avalanche rescue is technically much simpler. The systematic application of the search systems leads to success in a very high percentage of cases. The real challenge of avalanche rescue is the very small time span in which buried subjects can be located and excavated with residual survival chances remaining high.

Though intuitive, it is worth underscoring the critical importance of having the right resources at the right time and right place in the debris zone to optimize survival chances in avalanche rescue procedures.

To have companion rescuers act in a meticulous manner that optimizes survival chances is natural when taught correctly. Problems only occur when students receive erroneous avalanche rescue training, especially during introductory courses. Questions like “how do you proceed when this first victim is 2m deep?” need to be asked even in the very early stages of training so that actions are always aimed at improving survival chances With proper training strict adherence to search protocol is seen as the most normal way on how to assess avalanche rescue. The end result leads to a rational and common approach to remote reverse triage algorithms (6).

4.2 Best practices in companion avalanche rescue

Although the field test and conclusions focus on companion rescue, it may be assumed that many of the mentioned processes are equally recommended and applicable for organized avalanche rescue.

5. SEARCH TACTICAL CONCLUSIONS

5.1 Balancing speed and precision

A good balance between search speed and search precision is critical. The “airport approach” (1) is recommended as an efficient teaching method for this concept and the search process for a buried subject in avalanche rescue in general.

5.2 Signal Search

The signal search phase includes the detection of signals of various sources and is thus typically a search for multiple characteristics (Visual clues + audible clues + transceiver signals).

As modern avalanche rescue transceivers have visual information read outs, users tend to set their visual focus to the device even in signal search phase, when no visual information is given by the transceiver and all visual attention should be focused on the surface of the avalanche.

The instructions on how to hold the transceiver during signal search phase need to be enforced from the very beginning on.

The three dimensional rotation of the receiver does not cause any problems for novice companion rescuers. It is however important to point out emphatically that the 3D rotation movement should immediately cease when the first signal is received (completing the signal search phase). The signal search procedure is only reinitiated when the rescuer is so far from previously found buried subjects that no signal is received or if the avalanche rescue transceiver instructs the user to do so.

The transceiver must be held sideways to the head while doing the 3D rotation with the hand only and with the speaker facing towards the ear of the rescuer during signal search. Signal search is always, independent of the applied search technology, an audible search only and therefore there is nothing visual to see on the device. The entire visual focus of the rescuer is used in this phase for the detection of visible clues on the surface of the avalanche.

5.3 Coarse Search

The coarse search with modern avalanche rescue transceivers is fast, efficient, reliable and does not usually cause any problems. While following the field line, guided by the device, rescuers should try to keep the big picture of the scenario in mind and avoid having multiple rescuers search for the same buried subject. To keep this perspective and maintain verbal coordination between rescuers in this phase is a challenge. In a real situation only about 30% of rescuers are able to obtain such coordination. (The authors suggest this is a problem whose solution could be addressed through development of application specific networking protocol for avalanche transceivers.)

During coarse search, the presence of a direction indication is highly valuable, in particular for the novice and average experienced user groups. This is a clear warning that single antenna devices, analog or digital, are by 2008 inadequate for these user groups. In the context of optimizing survival chances it is not advisable to sell, promote or recommend single antenna devices to novice or average rescuers. This statement is equally valid for companion as well as for organized avalanche rescue.

5.4 Fine Search

Three antenna devices showed clear advantages over dual antenna devices in the fine search phase as misleading maximums of field strength do not exist to confuse users. To strictly insist during training on a systematic application of a grid search pattern with no rotation of the receiver and that the device be held on the surface of the debris is critical in this phase.

Specialized search strategies for deep burials with single and dual antenna devices have been purposely left out in this test. Triple antenna devices are the only appropriate answer to the problem of deep burials for companion rescuers on a novice and average training level.

5.5 Pinpoint search / spiral probing

The search device needs to be stored in receive position in a safe place on the rescuer's body. The search is NOT done at this point. It is important that this be made clear to the students. The new ICAR nomenclature — as it is applied in this document — supports this understanding. Probing (=pinpoint search) is an integral part of the search. Novice and intermediate level user groups are known to double rescue times if pinpointing with a probe pole is not part of their rescue procedure (transceiver and shovel only) (7).

Probing can only be efficiently applied with two hands on the probe. Gloves should be worn at all times when handling probes. The rescuer needs to follow the probe step by step so that the probe can always be applied between the feet of the rescuer. Only by this method is there enough control on the angle of the probe and an ergonomic position for the rescuers to push the probe into the debris. Rescuers show a tendency to make the increase of the spiral radius too small (i.e. 5cm instead of 25cm) which leads to a longer search time without a relevant increase in the probability of detection (search resolution too high compared to the size of the buried subject).

If transceivers with "marking" functions are available, this very helpful function needs to be taught and applied at this point. The "marking" confirms to the receiving device that the buried subject has been successfully located by the probe. "Marking" is applied at the end of every search process, independently of the amount of buried subjects!

5.6 Excavation

The V-shaped snow conveyor (5) has been the method of choice for this lesson. The base shape of the system may be applied independent of the number of rescuers involved (1 – x). In particular, if the buried subject is shallow, attention needs to be paid that a certain distance between probe pole and the rescuer in the tip of the V is respected in order to prevent impact on the buried subject and his potential respiratory cavity.

Surprisingly often, participants are incapable of cutting blocks efficiently with the shovel. Progress in these cases is limited as depth is gained at very moderate speeds only. Many rescuers are only scraping a few millimeters of hard debris away ("parmesan scraping") instead of cutting blocks and lowering the bed surface of the V continuously layer by layer. This discipline needs to be taught with practice by showing the proper procedure in the flat bed and the side walls of the V.

5.6 Multiple burials

The "mental map" of the avalanche rescue scenario is the fundamental base for a successful multiple burial search as well as critical logistical decisions. The concept of the "mental map" has to be introduced as the first step after the participant is capable of properly solving single burial scenarios. To properly recognize the situation is the most critical step. Digital indications on the screen of the avalanche rescue transceiver as well as interpretation of the analog tone provide information about the presence of a multiple burial situation and the number of buried subjects.

The interpretation of the analog tone is easy to learn and reliable if the negative selection approach is applied: Counting the number of different signals results in number of victims. In order to reliably determine 1 – 3+ victims, ask yourself:

1. Could this be only one signal? No: at least 2
2. Could this be only 2 signals? No: at least 3

For advanced searchers:

3. Could this be only 3 signals? No: 3+

Correct interpretation of the number of signals has to be made in conjunction with a distance indicator (or volume control as distance indicator).

Example: Three victims with changing distance indication between 3-5m and 4-8m:

Expect three buried victims in an approximate radius of 5 m

Mental map of burial situation:

How many victims are located at what approximate distance from me (rescuer) and from each other? The "Map" the most important base to choose the appropriate search strategy and to apply the appropriate logistical measures (where are the buried subjects located, how many rescuers should be used for which tasks, what equipment is needed where, etc.)

"Marking" features of an avalanche rescue transceiver are very helpful for all user groups, but the lower the training level, the greater is the difference between less and more experienced rescuers. Marking functions are not only valuable for situations with multiple burials in close proximity, but are equally important to force rescuers to break away from a zone were a single buried subject has already been located.

The "micro search strip" method (3,4) is recommended as a search strategy for multiple burials that is independent of receiver type.

If failures occurred concerning multiple burials in general and in the application of the "micro search strips" in particular, the cause of the problem has been—without a single exception—the rescuers did not properly recognize the situation. This stresses again the importance of the "mental map" and the interpretation of analogue sounds. Where as the vast majority of the companion rescuers are able to properly apply the different systems and search strategies, the main challenge is to make them slow down long enough to interpret the visual and audible information on the avalanche and on their transceiver.

5.7 Triage

The four remote reverse triage factors "terrain", "distance between rescuer and buried subject", "burial depth" and "vital signs" have been introduced and the triage algorithms instructed.

The triage algorithms make sense intuitively to participants and instructors should not hesitate to address this topic in a very early stage of the training.

5.8 Leadership in companion rescue

Companion rescue almost always suffers from a (severe) shortage of resources. Therefore the classic role of a dedicated site commander — a standard procedure in organized rescue — is not justifiable in companion rescue. The initiative for leadership in companion rescue must be taken by individual rescuers as the situation (event driven) requires it. The more experienced members of a companion rescue party have to keep a general overview of the situation, while still taking a very active part in the rescue. The later shows the dilemma of leadership in companion rescue: those who would be most capable as site commanders, are most needed to take advantage of the high survival chances in the first 15 to 20 minutes of burial time. Although the classical role of site commander may be compromised in a companion rescue, this does not eliminate the necessity of leadership. Therefore, this is another subject that should not be avoided, even in the training of novice avalanche rescuers.

5.9 The role of the instructor and why "KISS" fails

Instructors should not be afraid to be strict with participants on the systematic application of the rules taught during the lessons / workshops. To make the novice rescuers immediately and clearly aware of their mistakes at the moment they occur is the only way to bring the trainees to a higher level. In order to be able to do this, instructors must follow the rescuers step-by-step on the field and take advantage of the pedagogically most valuable moments for the trainee. Standing on the edge of the avalanche while the participants conduct the search and rescue effort is an inacceptable, unprofessional behavior for an instructor as all the critical pedagogical and didactical moments get missed. Constantly and closely following participants at all times will also prevent the instructor's behavior revealing clues about where the buried subjects are hidden.

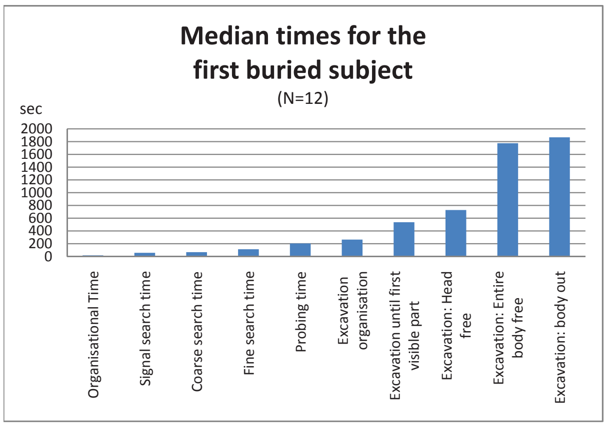
Rescuers on all levels participate in courses because they want to learn. However, many instructors limit the content of their practical or theoretical lessons to radically simplified rules and turn away participants with more detailed questions referring to the "Keep It Simple Stupid" (KISS) theorem.

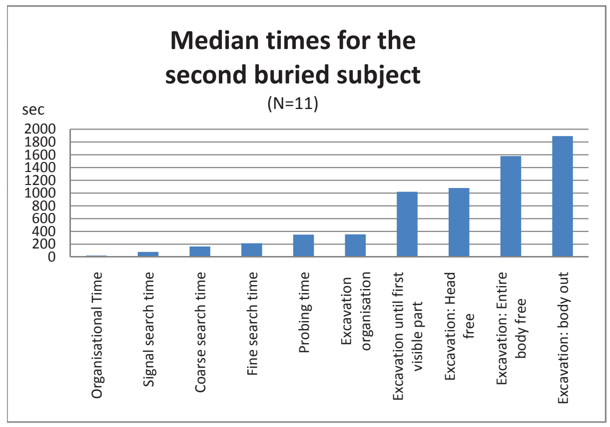
In this context, it is important to understand that "simplification" goes well beyond cutting away unnecessary details, simplification leads to a reduction of understanding. This in turn diminishes performance of a system beneath the minimum level required by the problems that need to be solved. Often, simplification is driven to a point where the loss of performance outweighs the benefits of reducing complexity for the rescuer.

Much more, KISS is has been abused as a personal defense strategy for reluctant instructors!

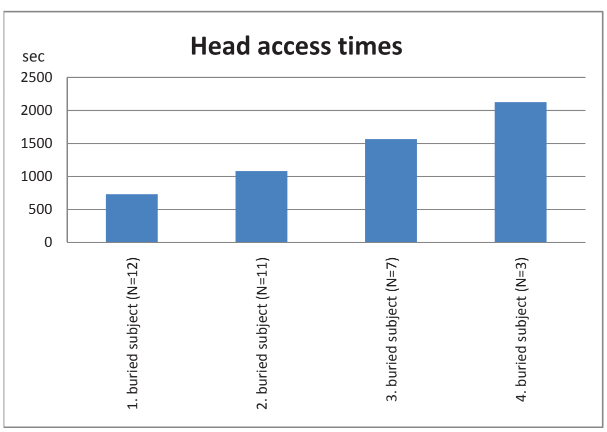
This way of responding to students as "stupid" shows little respect and interest for them, it is the instructor's role to teach efficient systems in a motivating, easy to learn manner. This mainly is a pedagogical and didactical challenge which requires a certain level of interest and dedication for a classical teacher's role.

6. RESULTS

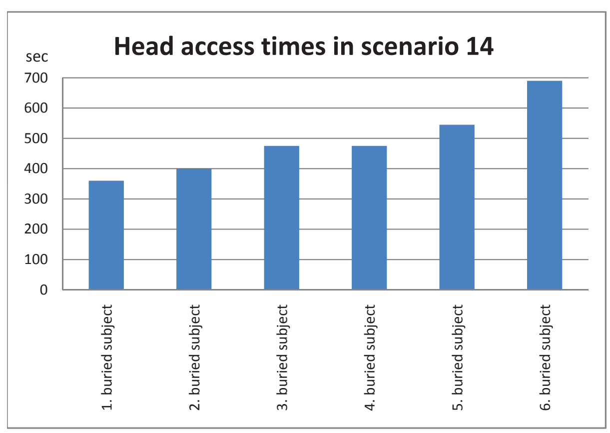




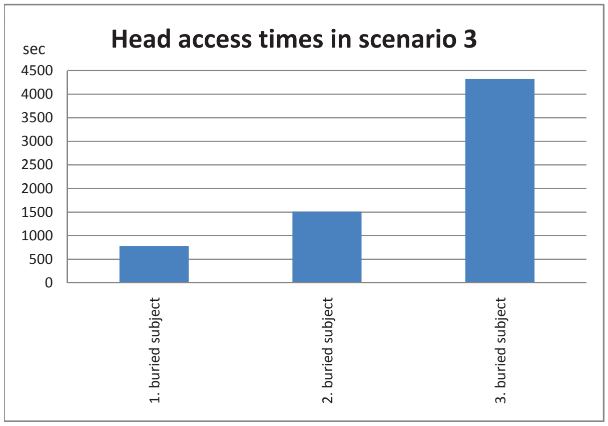
Median times for the different states of rescue for the first and second buried subject within the listed scenarios. The important increase in time between "head free" and "entire body free" shows the importance of being able to continue the search for remaining victims without the ability to switch off the transmitter of the previously located subjects.

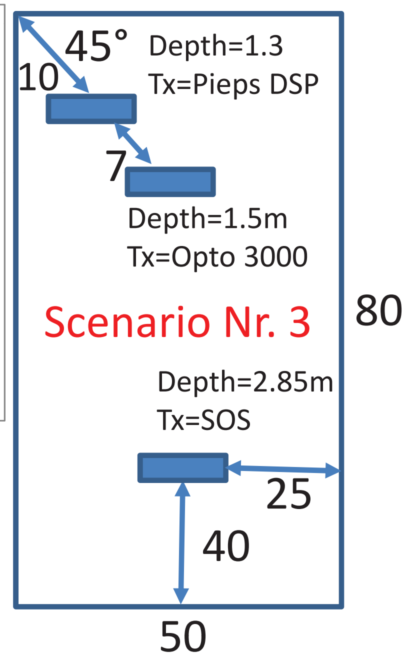


Median head access times for the first four buried subjects. Taken into account that burial depth and hardness of the debris was above average, results are very positive for companion rescuers with minimal training.

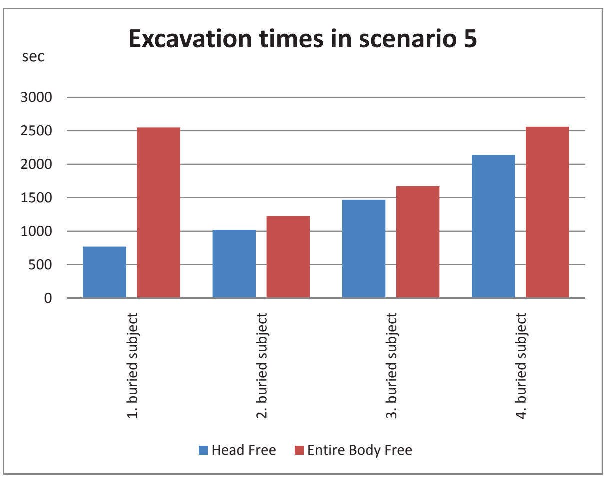


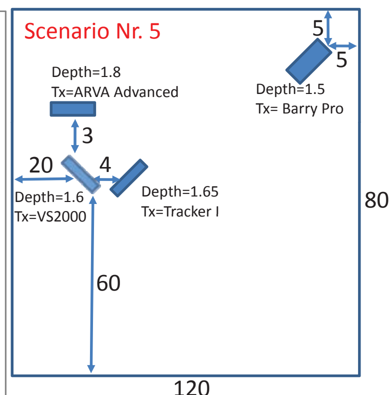
Head access times in a scenario with 6 buried subjects at 1m burial depths solved by eight companion rescuers.





Scenario 3 shows nicely the effect of remote reverse triage by burial depth. Entering the field from below, the closest buried subject was very deep so that the rescuers decided to directly proceed to the remaining two buried subjects. The head access times speak a clear language: Starting to dig at the first buried subject would with high probability have lead to a very bad outcome for all three buried subjects. Thanks to the properly applied triage decision, two subjects took advantage from head access times with reasonable chances of survival.





Excavation times in scenario 5: The first buried subject was responding so that the rescuers immediately continued with the rescue effort for the remaining buried subjects before completely freeing its body. The team showed an excellent performance looking at the complexity of the scenario and the above average burial depths.

Scenario	Number of rescuers	Number of buried subjects	Burial depth	Multiple burials in close proximity	Vital signs	Surface area of debris	Receivers	Transmitters	Remarks
1 + 2	For the training of data recording only								
3	4	3	1.30 m 1.50 m 2.85 m	Yes (2)	No	50m x 80m	3 antenna digital / analog with “marking”	Pieps DSP V4 Barry Opto 3000 SOS	Remote reverse triage by burial depth
4	3	3	1.55 m 1.60 m 1.75 m	Yes (2)	Yes	80m x 120m	3 antenna digital / analog with “marking”	ES1 as Ortov. F1 ES2 as Tracker I PulseBarryvox (transmitting “increased survival chances)	Remote reverse triage by vital signs

Scenario	Number of rescuers	Number of buried subjects	Burial depth	Multiple burials in close proximity	Vital signs	Surface area of debris	Receivers	Transmitters	Remarks
5	5	4	1.65 m 1.60 m 1.80 m 1.50 m	Yes (3)	No	80m x 120m	3 antenna digital / analog with "marking"	Tracker I Barry VS2000 Arva Advanced Barry Pro	
6	3	3	1.00 m 1.00 m 1.00 m	Yes (3)	No	50m x 80m	2 antenna digital analog without marking	Arva Evolution Tracker I Barry VS68	
7	2	2	0.80 m 1.50 m	No	No	50m x 80m	2 antenna digital analog without "marking"	ES5 as PiepsOpti ES6 as Ortov. M2	
8	2 +3 (shovelling only)	2	1.10 m 2.25 m	No	No	50m x 80m	3 antenna digital / analog with "marking"	SOS Pieps DSP V4	Remote reverse triage by burial depth
9	1	2	1.00 m 1.50 m	No	Yes	80m x 120m	3 antenna digital / analog with "marking"	ES1 as Tracker I PulseBarryvox (transmitting "increased survival chances)	Remote reverse triage by vital signs
10	3	4	1.00 m 1.00 m 1.00 m 1.00 m	Yes (3)	No	80m x 120m	2 antenna digital analog without "marking"	Barry Pro Tracker I Barry VS2000 Arva Advanced	
11	2	3	1.00 m 1.00 m 1.00 m	Yes (3)	No	50m x 80m	3 antenna digital / analog with "marking"	Barry VS68 Tracker I Arva Evolution	Last buried subject recognized by analog sound only
12	2	3	1.00 m 1.00 m 1.00 m	Yes (3)	No	50m x 80m	2 antenna digital analog without "marking"	Barry VS68 Tracker I Ortovox X1	
13	Not applicable								
14	8	6	1.00 m 1.00 m 1.00 m 1.00 m 1.00 m 1.00 m	Yes (1x3) (1x2)	No	80m x 120m	2 and 3 antenna digital analog with and without "marking"	ES1 as Ortov. F1 Barry VS2000 Barry VS68 Tracker I ES5 as SOS ES6 as Opto3000	Second last buried subject recognized by analog sound only
15	1	1	1.00 m	No	No	80m x 120m	3 antenna digital / analog with "marking"	Barryvox Pro	

7. CONCLUSIONS

The field test results prove that companion rescuers with minimal training can be highly efficient, even in situations which might previously have been seen as particularly complex and "out of reach" for companion rescuers.

The authors recommend that instructors follow in their teaching the guidelines as outlined in this paper and recommend rescue equipment which is adequate for the respective user group.

Acknowledgements

The authors would like to thank:

- Volda University College, Norway
  for providing their workforce and students.
- Helga Synnevåg Løvoll, Assistant Professor
- Ola Einang, Assistant Professor and president of the Norwegian mountain guide association
- Dag Erik Wold, Assistant Professor
- all participating students of the BA Physical Education and Outdoor Life program
  for their great effort, enthusiasm and discipline in the preparations and during the physically and mentally demanding field days.
- Norwegian Geotechnical Institute
- Krister Kristensen, NGI
- Norwegian School of Winter Warfare
- Maj Ellevold / Kapt Clausen & staff
  for their support in logistics and accommodation.
- Einar Løken
  for his hard work before and during the field test as well as his assistance with photos and filming.
- Craig Dostie, Editor Couloir Magazine
  for his linguistic and stylistic review of this paper.

REFERENCES

(1) Genswein, Manuel, The "airport approach", Teaching Methods, 2002.

(2) Genswein, Manuel, Spiral probing perpendicular to the snow surface, Teaching Methods, 2002.

(3) Genswein, Manuel - Harvey, Stephan, Statistical analyses on multiple burial situations and search strategies for multiple burials, Penticton BC (Canada), Proceedings ISSW 2002, 2002, 469-476

Search method only first published in 2000:

(4) Blagbrough, Steve - De Montigny, Jesse, Instructing students on how to conduct a multiple burial search using the micro search strip method, Telluride CO (USA), Proceedings ISSW 2006, 2006, pp 510-512.

(5) Genswein, Manuel - Eide, Ragnhild, The V-Shaped Snow Conveyor-Belt an Efficient Excavation Method in Avalanche Rescue, Whistler BC (Canada), Proceedings of ISSW 2008, 2008.

Excavation method only:

Genswein, Manuel - Eide, Ragnhild, The V-Shaped Snow Conveyor-Belt an Efficient Excavation Method in Avalanche Rescue, Pontresina GR (Switzerland), Proceedings of ICAR 2007, http://www.ikar-cisa.org, 2007.

(6) Genswein, Manuel - Thorvaldsdóttir, Sólveig, Remote Reverse Triage in Avalanche Rescue, Proceedings of ISSW 2008, 2008.

Triage algorithms only:

Genswein, Manuel, Remote Reverse Triage in Avalanche Rescue, Pontresina GR (Switzerland), Proceedings of ICAR 2007, http://www.ikar-cisa.org, 2007.

(7) Stumpert, Dominique, Dégagement des victimes d'avalanches, Chamonix-Mt-Blanc (France), Actes des Conferences TRACE02, 2002, 49-51