# SKI TOURING BITÁCORA- AN INNOVATIVE APPROACH FOR TRIP PLANNING, RECORDING OBSERVATIONS, AND RISK MANAGEMENT WHILE TRAVELING IN AVALANCHE TERRAIN

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ABSTRACT: The use of field books for recording weather, avalanche and snowpack observations is essential for recreationists, professionals, and snow scientists. Avalanche field books allow to each group to maintain situational awareness and track weather changes that impact snow stability. It's also an important operational tool that provides evidence of due diligence.

Field books have evolved from plain weatherproof paper with no graphics or text. For years, recreationists and professionals alike created their own forms to record relevant data. Eventually, preformatted books eased the recording of field observations. As these took shape, some field books put more emphasis into trip planning while other books provided better tools such as rose diagrams.

We developed a field book with the objective of improving the ergonomics and user interaction. The main goal was to develop a field book that is not only fun to use but also motivates the user to main-tain the habit of consistently using a field book while also employing a structured method essential for situational awareness.

The "Bitacora" field book uses an accordion design that improves the review process and data flow. This innovative pagination better integrates all the steps necessary to assess before a ski tour into individual panes. The "Bitacora" includes panes for regional and local avalanche forecasts, risk assessment, weather forecasts and critical weather factors, snowpack development, and more – all of which produces a mindful, operational and, we believe, a well-rounded trip plan. At the same time, the trip-plan transitions into a trip checklist and field observation panes. The panes are not limited to snow pit profiles, temperature profiles, or other weather and avalanche related panes, but also includes a Team/Human factor observation pane. Last, the compact size and format of the "Bitacora" fits better in ski pants and coats allowing for easier access.

KEYWORDS: Avalanche education, field book, field journal, ski touring planning.

#### 1. DECISION-MAKING AND SITUATIONAL AWARENESS

Decision-making is dependent on Situational Awareness (Jones, D, et all, 1996). Decisions as well as trip planning in avalanche terrain require accurate perception of the environment, understanding the interaction between terrain, snowpack development, weather, and project future status (Figure 1). If mistakes and error in decision-making are to be reduced, we need systems that assist us to improve situational awareness. Fortunately, it is recognized that the use of field books by avalanche enthusiasts and professionals is essential when traveling in avalanche terrain.

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## Situational Awareness What it is?

Situational Awareness: What is important around you!

Environment: Aggregate of surrounding things, conditions, or

influences; surroundings, cultural and/or social forces.

Situatio	onal Awareness	
Perception of Elements in Environment	Comprehension of Elements in Environment	Projection of Future Status in Environment
76% Errors	20% Errors	4% Errors

Figure 1: Situational Awareness Errors.

With that in mind, Avalanche Science LLC developed an avalanche field book named "Bitacora". Avalanche Science continues to evolve the field book concept into a solution that incorporates situational awareness and decision-making.

Key to this was the adoption of an accordion page design. The accordion design is an innovative approach to ease the planning of a ski tour and provide a natural flow of concepts, information, and observations. The "Bitacora" field book consists of a number of panes or images that guide the user through a detailed process. The workflow is based on the fundamentals of situational awareness. It systematically exposes the user to appropriate perception and understanding of the environment while nudging the user to anticipate the inherent risks of traveling in avalanche terrain.

#### 2. AVALANCHE CONCEPTUAL MODEL

The field book conforms to the latest version of the Avalanche Conceptual Model (Statham, G, et all, 2009). Without the conceptual model, risk assestment would not be possible.

Figures 2 and 3 illustrate the field book pages associated with avalanche danger and the identification of the avalanche problem.

Regional Danger - Mark numbers (1-4) in boxes for up to four concerns to rate avalanche danger, problem(s), likelihood, size.



Figure 2: Regional Avalanche Danger, Problem and Likelihood.

The implementation of the current version of the field book distinguishes between regional and local avalanche problem. This practice might be redundant at times, but it allows the user to factor local topography and weather effects.

The utilization of rose plots (Figure 3) encourages the user to predict and chart the spatial

distribution of the avalanche problem. This practice is useful in the cognition of aspect dependency of the avalanche problem prior to the tripplanning step.

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 Avalanche Problem(s) for Local / Ski Touring Area:

 Avalanche Danger Assessment:

 1) Identify avalanche problem for the local area targeted for travel.

 2) Prioritize avalanche problems; What are the primary two concerns?

Uncertainty analysis, identification of terrain to avoid, danger rating assignment, and risk analysis will be completed for the primary concerns in the next page (step 2).



# Figure 3: Avalanche Problem, Spatial Distribution and sensitivity.

The uncertainty factors impacting risk assessment are detailed in Figure 4. Uncertainty factors are important prior to generating the destructive size versus avalanche likelihood diagram.



Figure 4: Risk Assestment.

## 3. WEATHER AND SNOWPACK

The weather pane is unremarkable, but important. The entries are meant to shake out critical factors impacting instability. A subset of this pane is included in Figure 5.



Figure 5: Section of Weather pane.

Another step intrinsically linked to situational awareness skills is an exercise to anticipate a pit profile as well as stability test results. Figure 6 shows a section of the snowpack assessment where the projected profile is drawn. This exercise is not meant to generate accurate profiles, but to drive cognitive processed link to anticipation. Obviously this skill improves with experience and understanding of snowpack development processes.



Figure 6: "Snowpack assestment by projecting a hardness profile.

#### 4. TRIP PLANING AND CHECKLIST

The user generates a trip plan once it has completed the sequential field book entries for regional avalanche danger, avalanche problem, weather forecast, and snowpack assessment.

The trip plan pane (not shown for brevity) provides a template for recording trip objectives, turn-around times, sunset times, and a place to chart trip elevation versus time. The trip plan pane also incorporates other non-avalanche hazards and prompts the user to provide an emergency evacuation plan.

The trip checklist pane facilitates the verification of trip preparedness.

# 5. FIELD OBSERVATIONS

Recording observations and tests in a standardized format is encouraged by providing nomenclature consistent with The Snow, Weather, and Avalanche Observation Guidelines published by the American Avalanche Association (Greene, et all, 2016).



Figure 7: Observation Pane.

Other panes included in the "Bitacora" which provide versatility and functionality such as ski quality and stability roses, team/human factor observations, snow pit data, snow pit hardness profile, structural weakness assessment ("lemons"), and temperature profile. Panes with reference codes for crystals, stability tests, fracture character, avalanche classification, snow surfaces, sky cover, and wind speed are cleverly sprinkled through the "Bitacora" at strategic locations, where the user can easily refer to them.

#### 6. FIELD BOOK DESIGN

The design and workflow of any field book is essential in guiding the user through the acquisition of information and data that enhances situational awareness. We feel a notable enhancement is that the design contributes to a natural flow of information. The notebook provides easy reference annotations and observations without having to scroll through many pages.



Figure 8: Sample of Avalanche field books.

The "Bitacora" field book uses weather-proof paper and is double sided printed. The user only carries one accordeon booklet per day. The size of the "Bitacora" was selected to better fit into today's coats and pants pockets. This encourages users to keep their note taking materials accesible at all times as opposed to in a backpack.



Figure 9: Latest "Bitacora" Field Book.

The "Bitacora" relies on an accordion design (Figure 9) to facilitate sequential flow of every one of the steps required for trip planning, recording observations, and risk management. Figure 10 shows the sequence of steps to be completed by the user prior

to the ski tour, during the ski tour, and at the completion of the tour.

Bitácora:			
Pron. /bi'takora/			
Field journal for trip planning, recording observations, and risk management while traveling in Avalanche Terrain.			
Regional and Local Avalanche Forecast	5 Trip Plan		
2 Risk Assessment	6 Trip Checklist		
3 Weather Forecast	7 Field Observations		
Snowpack	8 Forms		
Complete steps 1 through 6 before trip start			

Figure 10: "Bitacora" Field Book steps.

Samples of the Bitacora will be available during the poster presentation of this paper.

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