

Monitoring methods of recreational activities in outdoor areas

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Suivre la fréquentation en montagne aujourd'hui: méthodes, enjeux et perspectives. 16 Mai 2022 - Amphithéâtre du Pôle Montagne (UMR EDYTEM - Bourget du Lac) - Zoom



Objectives

- Deliver an overview of visitor monitoring methods
- Explore the applicability of existing visitor monitoring methods and technologies for backcountry recreation
- Deliver examples of methods' usage



Agenda

- Introduction
- Overview methods
- Some examples
- Conclusion



Increasing backcountry skiing and snowshoeing in Switzerland



Data: Lamprecht et al. 2009, 2015, 2017, 2020; Bundesamt für Statistik 2017

Main References

- Langford R, Haegeli P, Rupf R (2020). How much recreational exposure to avalanche terrain is there? - An overview of possible approaches for monitoring winter backcountry use for public avalanche-warning services. 172 p. https://www.avalancheresearch.ca/pubs/ 2020_monitoringreport/
- Monitoring projects of ZHAW Environmental Planning Group

How much recreational exposure to avalanche terrain is there?

An overview of possible approaches for monitoring winter backcountry use for public avalanche-warning services

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> > January 25, 2020

Prepared for

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Monitoring methods in 7 categories



A) Manual observation methods

- 1. Direct in-situ counting
- 2. Nonparticipant direct monitoring
 - 3. Citizen science observation methods

B) Automated observation methods

- 1. Pressure-sensitive counters
- 2. Light barriers and infrared counters
 - 3. Radio frequency identification systems (RFID)
- 4. Photography and video monitoring from fixed locations
 - 5. Radar detection from fixed locations
- 6. Aerial photography
 - 7. Satellite imagery

C) Mobile tracking systems

- 1. Satellite-based
 - a. Targeted GNSS tracking (GPS trackers)
 - b. GNSS/GPS web-sharing services (STRAVA, Endomondo, GaminConect, ...)
- 2. Land-based tracking system (mobile phone tracking)

D) Voluntary self-reporting

- I. Summit registries and hut guestbooks
 - 2. Self-registration boards
- 3. Online backcountry community platforms (hikr.org, CapToCamp.org, Trailforks.com, ...)
 - General location-based social media platforms → Volunteered Geographic Information, Geo-tagged photographs

E) Compulsory registration

1. Trip permits and registrations

F) Surveys

- 1. Intercept surveys (specific site)
 - 2. Targeted research surveys (internet, mail, phone \rightarrow research sample!)
 - 3. Cross-sectional participation surveys (large sample / census, nation-wide)

G) Other methods

- I. Use estimates by local experts
 - 2. Indirect evidence (secondary data)
 - a. Hotel and hut booking
 - b. Transportation bookings/tickets
 - c. Vehicle counts at staging areas/parking lots
 - d. Ski area boundary gates



Characteristics

Type of personal information detectable

- Identity (of individuals)
- Individual characteristics (of recreationists)
- Additional insights into behavior

Type of spatial and temporal information collected

- Spatial information
- Spatial extent
- Temporal resolution
- Reliability
 - Reliability

Potential impacts on study subjects

- Potential of affecting behavior
- Potential of privacy concerns
- Costs
 - Equipment
 - Implementation
 - Effort and complexity of analysis



ing metho	bx	Identity	Indiv. character.	Additional insight	Spatial information	Spatial extent	Temporal resol	Refability	Affecting behaviour	Privacy concerns	Equipment cost	Implement. cost	Effort of analysis	Wimher suitability	
ual obser	vation method	ds													
ect in-situ	counting	Yes	Some	None	Move	Local	High	Higher	Low	None	Lower	Higher	Lower	Yes	
nparticipa nitoring	int direct	Yes	Some	Some	Move	Local	High	Mod	Low	Low	Lower	Higher	Mod	Yes	
zen scien ervation r	nce methods	No	Some	None	Position	National	Med	Lower	Low	Low	nia	Higher	Higher	Yes	
mated of	bservation me	thods	_	_											
ssure-ser	nsitive	No.	Mana	Name	0	1	and a	1	1.000	Mana	1	1	1	84a	
Monitor	ing method		Identity	Indiv. character.	Additional insight	Spatial information	Spatial extent	Temporal resol.	Reliability	Affecting behaviour	Privacy concerns	Equipment cost	Implement cost	Effort of analysis	Winter suitability
c) Mobi	le tracking sys	stems													
Tan	geted GNSS tra	acking	Yes	Detail	Some	Track	Local	High	Higher	High	Consent	Higher	Mod	Mod	Yes
GN: sen	ISS web-sharing vices	9	Yes	Some	Some	Pos Track	Nation	High Low	Mod	nia	Mod	n'a	Mod	Mod	Yes
Mot	bile phone track vidual records	king –	Yes	None	Some	Track	Nation	High	Mod	nia	High	n'a	Mod	Mod	Yes
Mot agg	bile phone track regate data	king –	No	None	None	Poe	Netion	High	Mod	nia	Mod	-	Mod	Lower	Yea
d) Volu	ntary self-repo	orting													
Sun gue	mmit registries a istbooks	and hut	Yes	None	None	Pos	Local	Med	Lower	nia	Low	nia	Lower	Lower	Yes
Self	f-registration bo	ards	Yes	Some	None	Pos	Local	Med	Lower	Low	Low	Mod	Lower	Lower	Yes
Onl	ine backcountry	Y.	Yes	Some	None	Pos	Nation	Med	Lower	nia	Mod	nia	Lower	Higher	Yes
Gen	e) Compulso	ry regist	ration	-	-	-	-	-	-		-	-	-	-	-
50C	Trip perm registratio	its and ins		Yes	Some	None	Pos/ Move	Local	Med	Higher	Low	Low	nia	Lower	Lower
	f) Surveys														
	Intercept :	surveys		Yes	Detail	Detail	Pos/ Move	Local	High	Higher	Mod	Consent	Lower	Higher	Mod
	Targeted surveys	research		Yes	Detail	Detail	nia	Nation	Low	Mod	Mod	Consent	Lower	Mod	Hgher
	Cross-sec participati	ctional on surve	ys	No	Some	None	inia	Nation	Low	Higher	Mod	Consent	nia	Higher	Lower
	g) Other meth	hods													
	Use estim experts	nates by I	local	No	None	None	Pos/ Move	Local	Med	Mod	nia	None	nia	Mod	Mod
				1											

https://www.alamy.com/



First step



https://spvggeschenau.de/bogenschiessen



Second step – overview C1b) GNSS/GPS web-sharing services (sports community – e.g. STRAVA heatmap)







Second step – overview D3) backcountry sports community websites

Index Index Index Index Index Index Index Index Index Index Index Index Index Index Index Index <				HOME JOURNAL REGIONEN FOTOS GEO MAP COMM LEUTE Suchen
Gipfelbuch.ch Nome GipFelbuch PINBOARD AKTUELL TOOLS ABO GIPFEL & ROUTEN (TOURENFÜHRER) FINBOARD AKTUELL TOOLS ABO Image and fair personal states and the person			find your medical exp	Glarus » Skitouren Welt » Schweiz » Glarus
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G1) expert estimations on visitor use





Deeper insight – G1) expert estimations on wildlife habitats



... if there are no experts \rightarrow A2) Nonparticipant direct monitoring





Automated observation B4) Photography (colour and infrared) and B2) Infrared counters and induction \rightarrow positioning



Data analysis \rightarrow e.g. GLM





Time period: 10.6.2020 - 22.10.2020



C1a) GPS monitoring – Backcoutry trips 2010/11 Biosfera Val Müstair



Combined Methods

- B4) Automatic cameras
- B2) Pyrosensors
- B4) Counter slope images



B4) Automatic camera (Reconyx Hyperfire)



0°C

B2) Pyrosensor (Eco-counter)



HC600 HYPERFIRE

zh aw

B4) Counter slope images – after snow falls

Snow cover Sta. Maria













B4) Detected descent skiing tracks – 10 days after snow fall (16.3.2021)





B6) Aerial photo - plane

- 2 flights high winter
- 1 flight late winter





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B6) Aerial photos





B6) Aerial photo - drone (Wingtra)



⊐ km

0.6

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IUNR Institut für Umwelt und





Comparison of use intensity: estimations wildlife managers (WM) and private experts (PE) vs. automatic cameras (AC)

	None	None	Few	Few	Medium	Medium	High	High
	WM-AC	PE-AC	WM-AC	PE-AC	WM-AC	PE-AC	WM-AC	PE-AC
P-value Wilcoxon test	.229	.821	.083	.252	.318	.903	.016	.039

• High use (>30 people / day) is generally underestimated.



D1) Self registration - Summit books



13.08.2017 Lena Rhyner, Elm Walter Elmer Ruedi Ehner

19.8.17 Hira + Toger Tosch Schlieren

21.8.17 Romano Fuer', Methinen Jutos 250LTI, Nodszeg, SLOUNKIA

23.8.17 Thomas Paul; Mit Bike bis Obererly von Elmans

25.8/A Lesterivite - Chlichopf -Gross Charge (for night Einheimische gre ment entreh den Itg zu finden i)

Hompe, Linus, Mit 245 dem. Ercher Oberlan

27.8.17 Roland + Hildegard Kad Shelo, " Offingen 298.2017 Greth Streill Elin cin spiklein leuchtet aber den Wald as rull mich, es right mid es fut mir Gewall. was machst du noch unter in Tenschangewihe hieroben ist's einsam hier oben ist's kahl. 30,8,17 -Fritz Rhyner Haslen Schwarz Tickingel - Karpf-Hl. Karpf Legler Halle

27.8.17



Conclusion – which method to use?



https://blogs.sas.com/

Characteristics of monitoring methods 1

Monitoring method	Identity	Indiv. character.	Additional insight	Spatial information	Spatial extent	Temporal resol.	Reliability	Affecting behaviour	Privacy concerns	Equipment cost	Implement. cost	Effort of analysis	Winter suitability
a) Manual observation methods													
Direct in-situ counting	Yes	Some	None	Move	Local	High	Higher	Low	None	Lower	Higher	Lower	Yes
Nonparticipant direct monitoring	Yes	Some	Some	Move	Local	High	Mod	Low	Low	Lower	Higher	Mod	Yes
Citizen science observation methods	No	Some	None	Position	National	Med	Lower	Low	Low	n/a	Higher	Higher	Yes
b) Automated observation me	thods											1	
Pressure-sensitive counters	No	None	None	Pos	Local	High	Lower	Low	None	Lower	Lower	Lower	No
Light barriers and infrared counters	No	None	None	Pos	Local	High	Mod	Low	None	Higher	Lower	Lower	Yes
Radio frequency identification systems	Yes	None	None	Pos	Local	High	Higher	Low	Consent	Higher	Lower	Lower	Yes
Photography from fixed locations	Yes	Some	Some	Pos Move	Local	High	Mod	Low	High	Mod	Mod	Higher	Yes
Video monitoring from fixed locations	Yes	Some	Detail	Move	Local	High	Mod	Low	High	Higher	Mod	Higher	Yes
Radar detection from fixed locations	No	None	None	Pos Move	Local	High	Higher	Low	Low	Higher	Mod	Higher	Yes
Aerial photography	No	None	None	Pos	Regio	Med	Mod	Low	Low	Higher	Higher	Higher	Yes
Satellite imagery	No	None	None	Pos	Regio	Med	Lower	n/a	None	n/a	Higher	Mod	Yes

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Characteristics of monitoring methods 2

Monitoring method	Identity	Indiv. character.	Additional insight	Spatial information	Spatial extent	Temporal resol.	Reliability	Affecting behaviour	Privacy concerns	Equipment cost	Implement. cost	Effort of analysis	Winter suitability
c) Mobile tracking systems													
Targeted GNSS tracking	Yes	Detail	Some	Track	Local	High	Higher	High	Consent	Higher	Mod	Mod	Yes
GNSS web-sharing services	Yes	Some	Some	Pos Track	Nation	High Low	Mod	n/a	Mod	n/a	Mod	Mod	Yes
Mobile phone tracking – individual records	Yes	None	Some	Track	Nation	High	Mod	n/a	High	n/a	Mod	Mod	Yes
Mobile phone tracking – aggregate data	No	None	None	Pos	Nation	High	Mod	n/a	Mod	n/a	Mod	Lower	Yes
d) Voluntary self-reporting													
Summit registries and hut guestbooks	Yes	None	None	Pos	Local	Med	Lower	n/a	Low	n/a	Lower	Lower	Yes
Self-registration boards	Yes	Some	None	Pos	Local	Med	Lower	Low	Low	Mod	Lower	Lower	Yes
Online backcountry community platforms	Yes	Some	None	Pos Move	Nation	Med	Lower	n/a	Mod	n/a	Lower	Higher	Yes
General location-based social media platforms	Yes	Some	Some Detail	Pos Move	Nation	Med High	Lower	n/a	Mod High	n/a	Lower	Higher	Yes



Characteristics of monitoring methods 3

Monitoring method	Identity	Indiv. character.	Additional insight	Spatial information	Spatial extent	Temporal resol.	Reliability	Affecting behaviour	Privacy concerns	Equipment cost	Implement. cost	Effort of analysis	Winter suitability	
e) Compulsory registration														
Trip permits and registrations	Yes	Some	None	Pos/ Move	Local	Med	Higher	Low	Low	n/a	Lower	Lower	Yes	
f) Surveys	f) Surveys													
Intercept surveys	Yes	Detail	Detail	Pos/ Move	Local	High	Higher	Mod	Consent	Lower	Higher	Mod	Yes	
Targeted research surveys	Yes	Detail	Detail	n/a	Nation	Low	Mod	Mod	Consent	Lower	Mod	Higher	Yes	
Cross-sectional participation surveys	No	Some	None	n/a	Nation	Low	Higher	Mod	Consent	n/a	Higher	Lower	Yes	
g) Other methods														
Use estimates by local experts	No	None	None	Pos/ Move	Local	Med	Mod	n/a	None	n/a	Mod	Mod	Yes	

To take home ...



- Set your objectives! and (often) choose a combination of methods (incl. secondary data)
- BUT we always could deliver monitoring data as a valuable basis for further negociations in participation of our partners

Langford R, Haegeli P, Rupf R (2020). How much recreational exposure to avalanche terrain is there? – An overview of possible approaches for monitoring winter backcountry use for public avalanche-warning services. 172 p. https://www.avalancheresearch.ca/pubs/2020_monitoringreport/



Thank you,

enjoy your walks and rides!



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... and