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Final Report of the

HANG II/HAWAS - Project

(Historical Analysis of Natural Hazards/
Historical Analysis at the Regional Agencies for Water Management)

Contracting authority: Bavarian State Ministry for Environment,
Public Health and Consumer Protection

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Final Report about the Analysis of Historical Hazards in the Archives of the Regional Agencies for Water Management HANG II /HAWAS

1. About the HANG/HAWAS Project

The project HANG/HAWAS deals with the historical analysis of natural hazards in the Bavarian Alps. In 2004 the archives of the four Regional Agencies for Water Management (WWA) in Kempten, Weilheim, Rosenheim and Traunstein were thoroughly scrutinized for any evidence of past hazardous events, from pure indications to detailed descriptions. Mainly written data was found, sometimes supplemented by maps and photographs. The project chiefly focuses on floods, debris-flows, land-slides, rock-falls and snow avalanches.

It was the aim of the project to detect all information not yet being electronically collected and to sore it in a database. After a twelve-month research more than 9000 records could be listed electronically. As a next step the data was overhauled by deleting double records and combining similar information. Finally the number of utilisable datasets was reduced to 8085.

Fig. 1 shows the proportion of the four Regional Agencies for Water Management in the findings. It can be observed that the agencies of Kempten, Weilheim and Traunstein provided a similar amount of data. In Rosenheim natural hazards have been registered electronically since 1989. Therefore hazardous events between 1989 and the present were not fed into the HANG-database. For that reason the amount of datasets gained from the archives of the agency of Rosenheim is about half the number of the others (cf. Fig. 1)

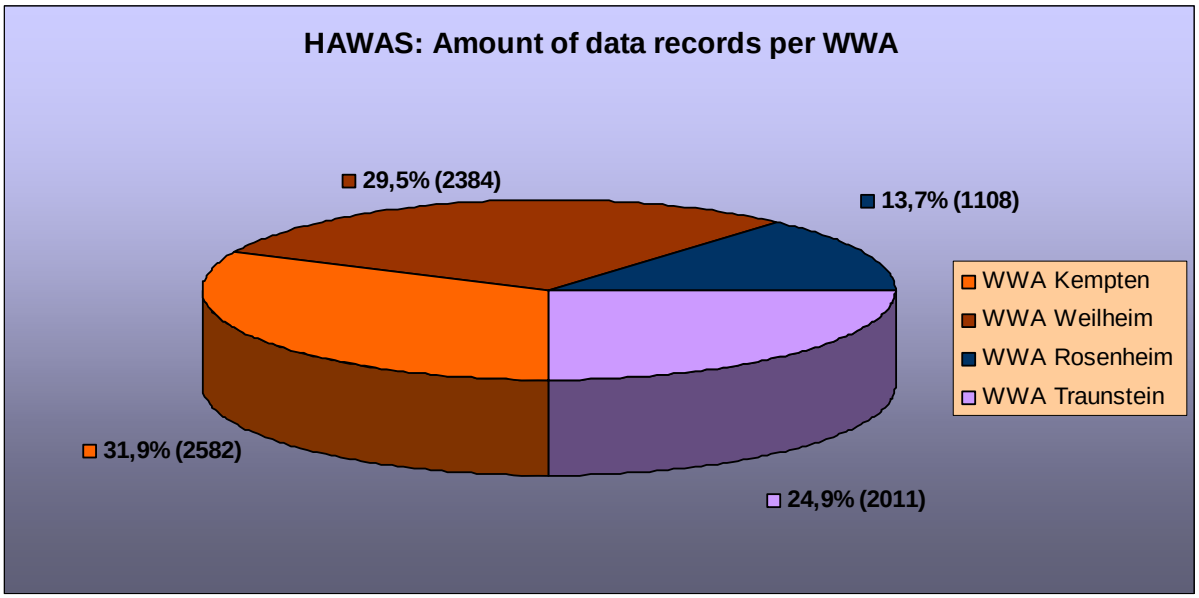


Fig. 1: Amount of data records per Regional Agency for Water Management (WWA)

In a second stage of the project the stored data was evaluated and analysed (January – June 2005).

This report provides an insight into the current data stock and gives some suggestions for the upcoming research of the next steps of the project.

2. Experiences of the Research

2.1 Methodology

Data collection

For the needs of the research work of HANG/HAWAS a data base, specially for the needs of the project was created. With the help of it all the information dealing with hazardous events were electronically collected. Apart from the basic original quotation, primary information, i.e. place, type and time of the event were recorded. In addition, references about damage and destructions, as well as measurements, cause, extent and frequency were stored. However sources often provided little information. Older sources in particular frequently lacked specification about place and time, by just indicating hazardous events without giving detailed data. For that reason the original quotation was literally adopted into the database, which often allowed precise identification at the later analysis.

In some cases even the type of the event could hardly be inferred from the source, since descriptions often merely referred to damage caused by deposits, which, in theory, can originate from floods as well as debris flows. In addition, writers of the sources sometimes were no experts, so that mistakes in the denomination of events could occur.

To reduce the time and effort in the agencies hardly legible documents (peculiar German handwriting until about 1950) as well as very extensively detailed descriptions were photocopied and worked on later. Moreover, photographs, site plans and maps were scanned for a later use in the database.

Revision

The revision of the database mainly focused on the localisation of each data record. With the help of digitised maps and the description of the hazardous events coordinates were detected to visualize the positions of damage by a GIS. However, most descriptions did not allow a precise localisation. The main reasons for this are:

- The source lacks a description of place
- Locations often do not exist anymore (e.g. houses, bridges etc.)
- Some locations (esp. in old sources) are given colloquial names that cannot be detected in current maps
- Names of places have changed and therefore cannot be found in current maps

In most of these cases coordinates were yet determined. The majority of descriptions allowed at least a rough detection of the localisations by giving approximate information like e.g. “upper reaches”, names of streets, etc.
In addition to coordinates catchment areas were added to the datasets.
To reduce the volume of the database, identical records were deleted and complementary information was combined.

Analysis
As a final step of the project the data was analysed. The main focus of the analysis of the data lay on the following questions:

- How many different events have affected a certain place (mainly torrent)?
- Which communities have been remarkably affected by hazardous events?
- Are there any years with a strikingly high number of affected places?

2.2 Time and Effort

The collection of data implicated the problem, that the expenditure of time could barely be assessed. In the end data collection at the archives took almost one year, thus doubled the estimations of the planning. Even during the work at the archives estimations could hardly be made. The reasons are:

- Partly non-systematic storage of files
  In most agencies files were stored in different archives and offices.
- Multitude of files
  A large number of files had to be checked for information, which often turned out to be irrelevant afterwards.

3. Characteristics of the Data

3.1 General Characteristics

The majority of the documents were in written form, only rarely supplemented by photographs and maps. The gained information shows the following characteristics:

1. Most records indicated floods, sometimes debris flows. Geological and geomorphologic hazards seem to be underrepresented in the archives of the Regional Agencies for Water Management. Comparisons to the data of the test stage of HANG (which included the archives of local authorities) strongly suggests this assumption.
2. The quality of the data can be valued as highly credible and authentic, since most of the documents had been written by experts for water management. Only some sources based on historical transmission.
3. Since professional water management has not begun until the middle of the nineteenth century most documents did not date back any further than about 1850.

3.2 Volume of the Data

The HANG database contains 8085 different data records. The majority of the data deals with hydrological events like floods (79.5%) and debris flows (3.0%). Geological and geomorphologic hazards have a proportion of 11.4%. Other events like snow avalanches, storms and hail are of minor importance (3.9%). Only few records could not be assigned to any of the types, since the descriptions were too vague (2.2%), (Cf. Fig. 2.).

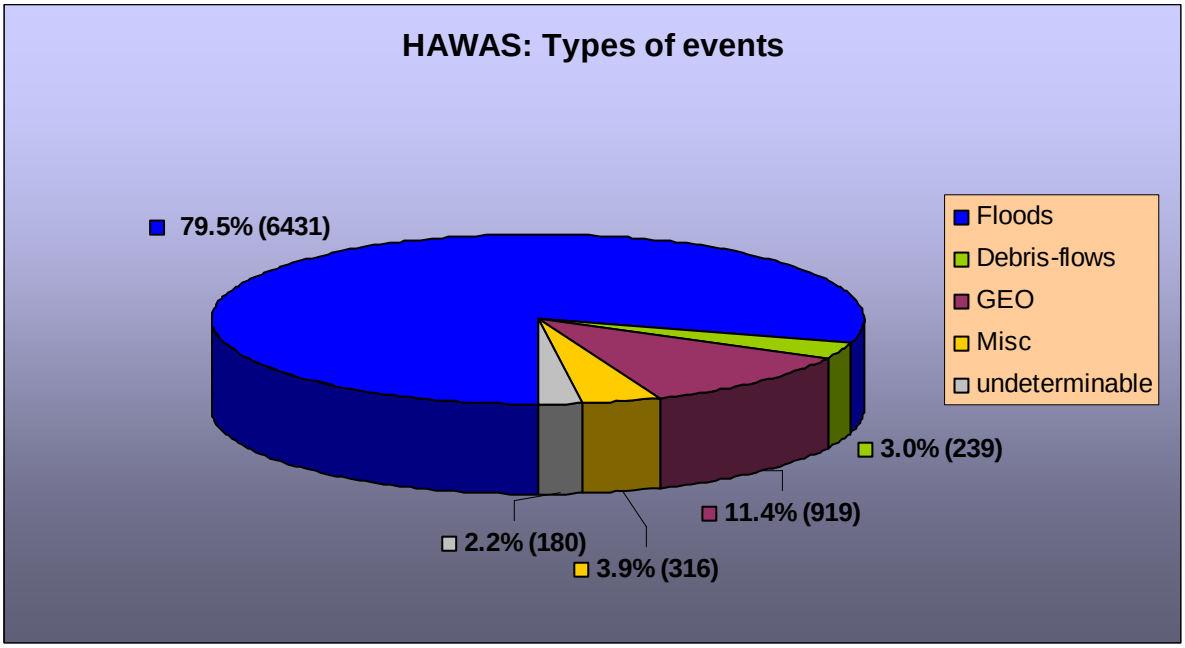
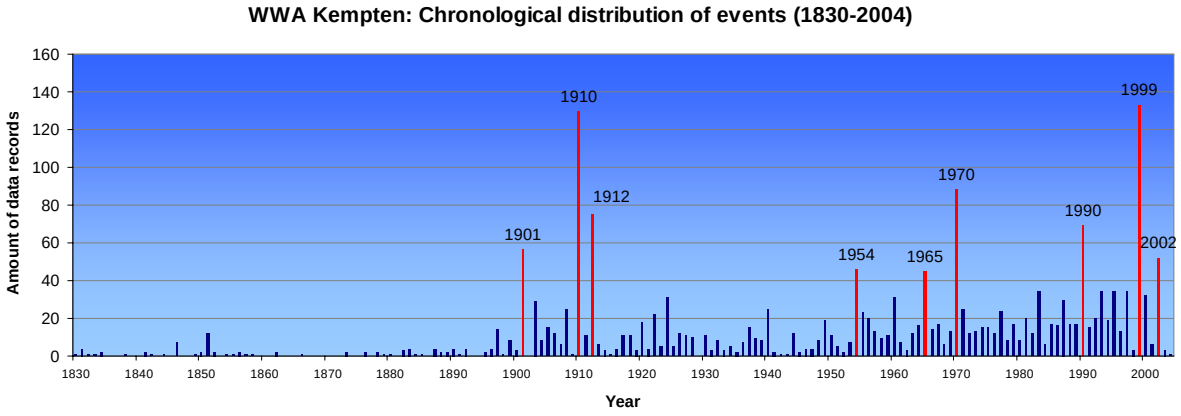


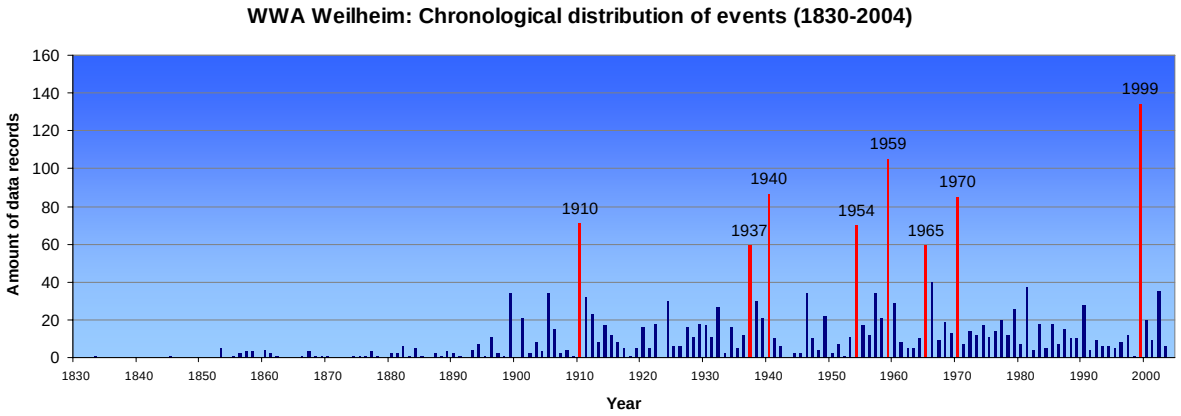
Fig. 2: HAWAS: Proportion of the types of events of the documented hazards

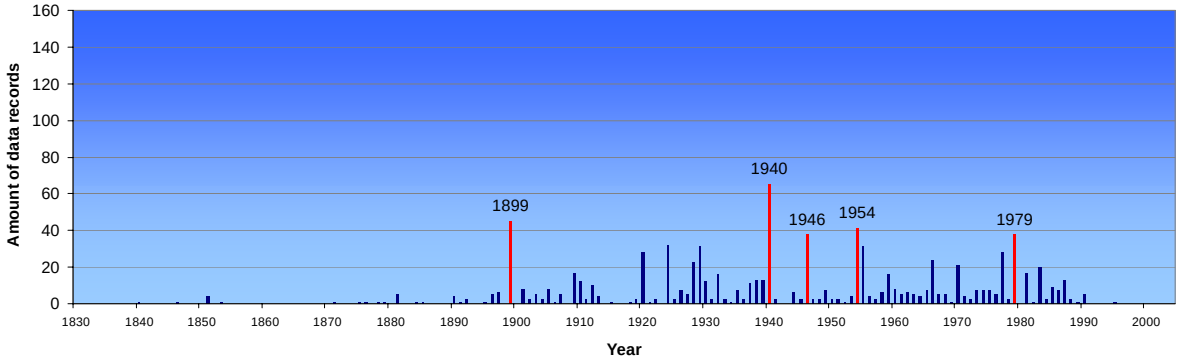
3.3 Time Analysis of the Records

As mentioned above, most findings refer to the last approx. 150 years. Nevertheless older documents could be detected in few cases. Those documents usually were no contemporary sources, but rather originated from historical tradition such as chronicles. In some cases that “second-hand” information dated back to the late middle age, a few even as far as the year 781.

Fig. 3 to 6 show the chronological distribution of the data for each of the four Regional Agencies for Water Management. The years most frequently represented are highlighted.







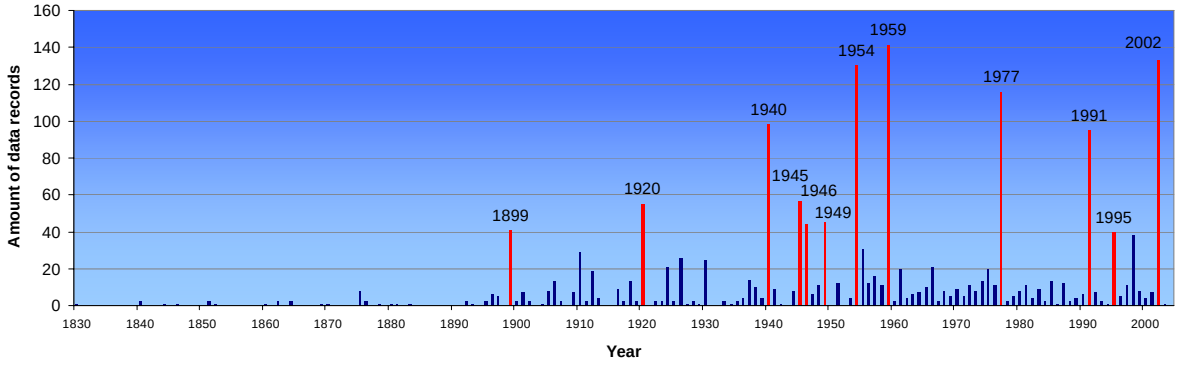


Fig. 3-6: Chronological distribution of events

On closer examination it can be realised, that there are some event years of comparable importance in the archives of several agencies, though just few years can be referred to as “remarkable” in all four areas (cf. 1954: all agencies; 1940: areas of Weilheim, Rosenheim and Traunstein; 1910, 1970 & 1999: areas of Kempten and Weilheim). From this it can be deduced that only in some very few cases hazardous events have similar effects on a supra regional scale. However even these far reaching events can have a different local dimension, which can be inferred from the different number of findings in each archive.
For that reason it is necessary to have a closer look at smaller areas (eg. communities, catchment areas, single torrents, etc.) in order to gain knowledge of the exposure of a certain place in the Bavarian Alps.

Annotation: There are typical weather situations, often causing hazardous events on mountain torrents

- *Local thunderstorms*
- *Large scale meteorological conditions, like the Vb-cyclone (2002) usually reach as far as the Inn. A north-west-stream, on the contrast, can affect the whole of the Alpine region.*

From the collected data, first conclusions about the frequency of huge hazardous events can be drawn. As it could be expected there are no big differences between the areas of the four agencies. For the 20th century it can be stated that catastrophic events happen every 15 to 20 years.

3.4 Municipalities of the Bavarian Alpine Region

The archives of the regional agencies of the Bavarian Water Management have provided significant data of the last approx. 150 years. A first analysis of the data shows, that documented events are represented by 2 to 3 data records on the average. Therefore, in order to assess the risk of hazardous events in the Bavarian Alps, it is necessary to access further archives covering a wider period of time as well as additional information to supplement the existing data. For this purpose archives of local authorities can make a valuable contribution, since most of them have files dating back several centuries.

To coordinate further research the gathered data was localised and then sorted according to municipalities. The result gives some ideas about the exposure of certain municipalities, depending on the number of findings and the number of hazardous events in their areas (cf. Fig 7 to 10).

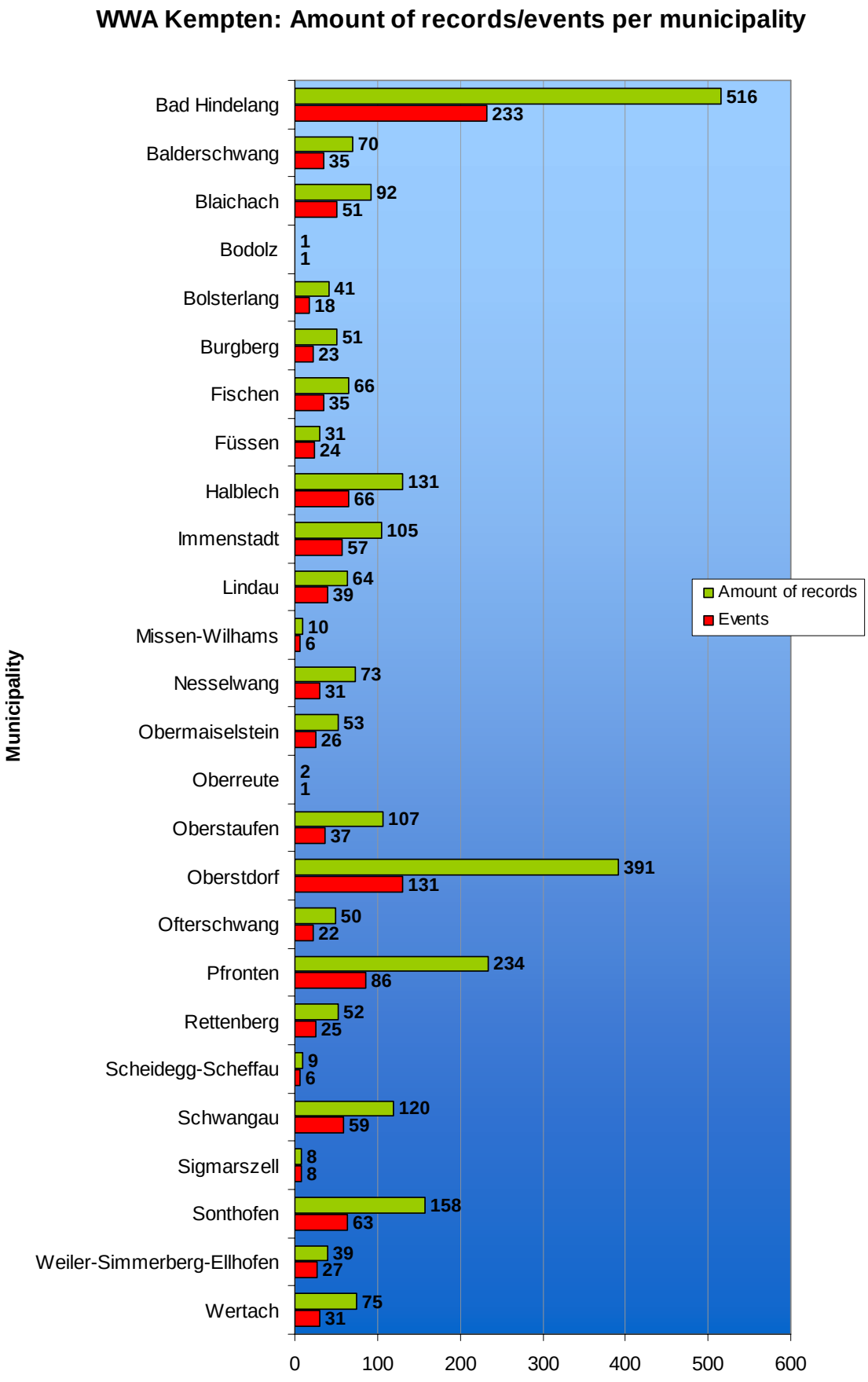


Fig. 7: WWA Kempten: Amount of records/events per municipality

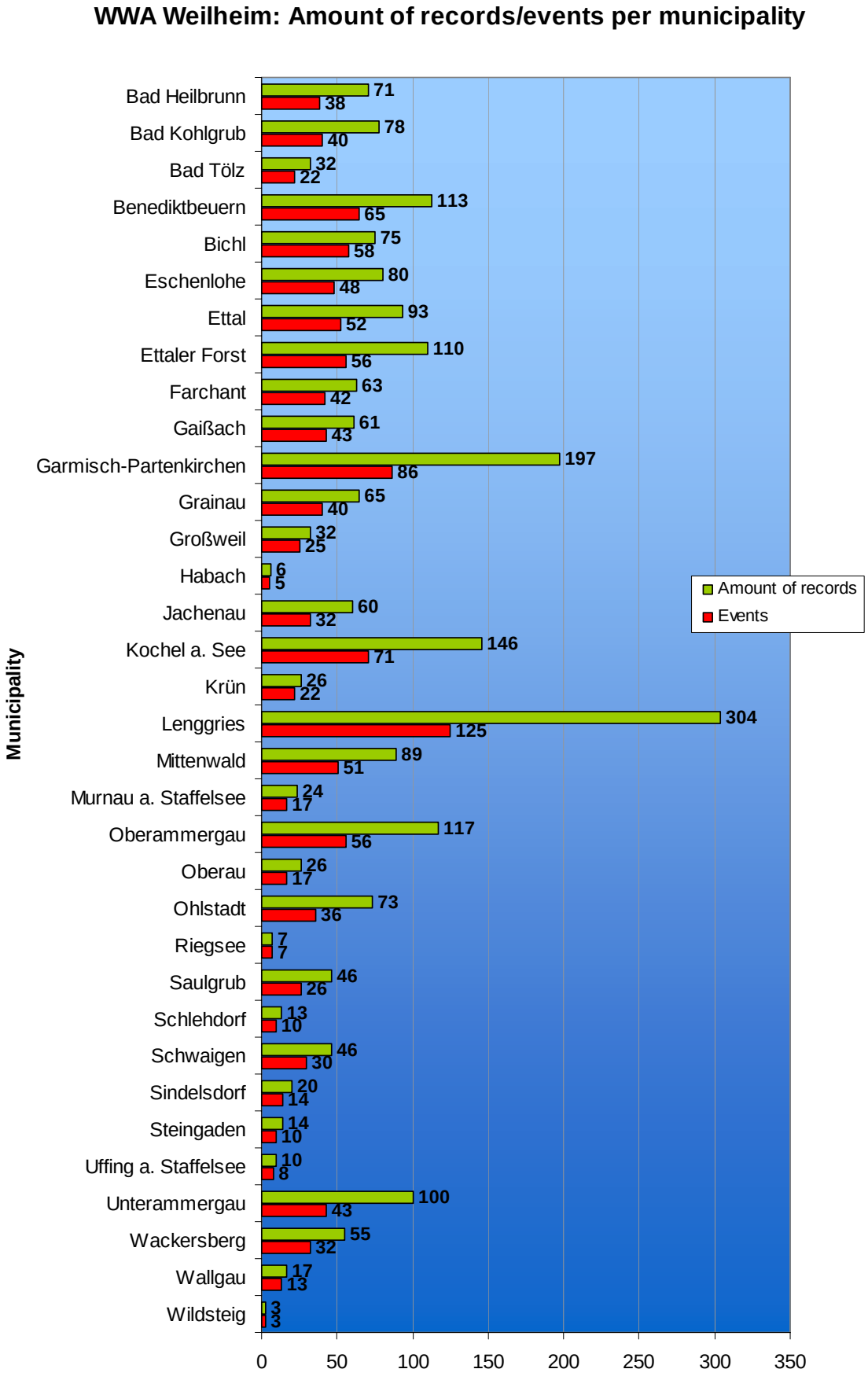


Fig. 8: WWA Weilheim: Amount of records/events per municipality

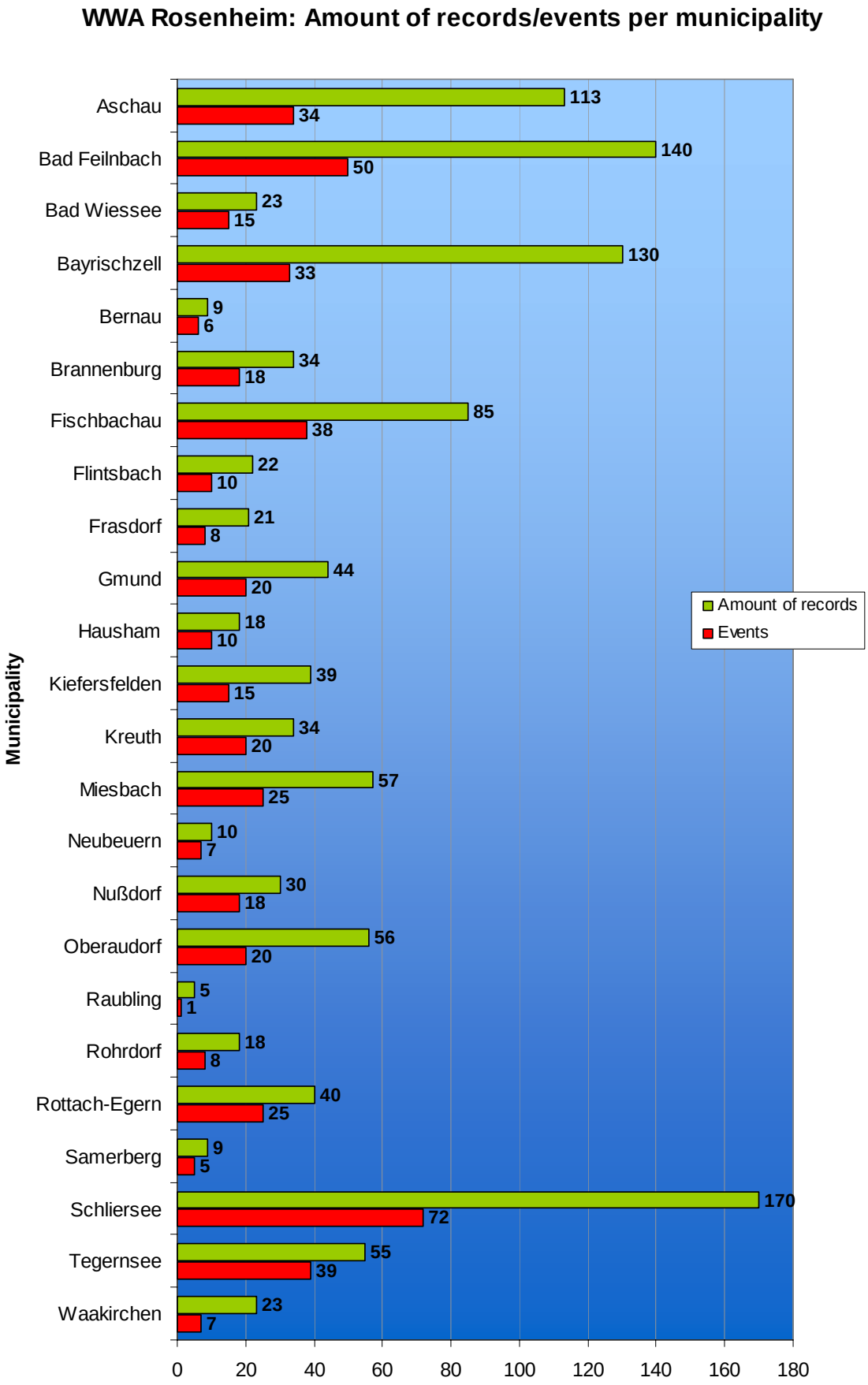


Fig. 9: WWA Rosenheim: Amount of records/events per municipality

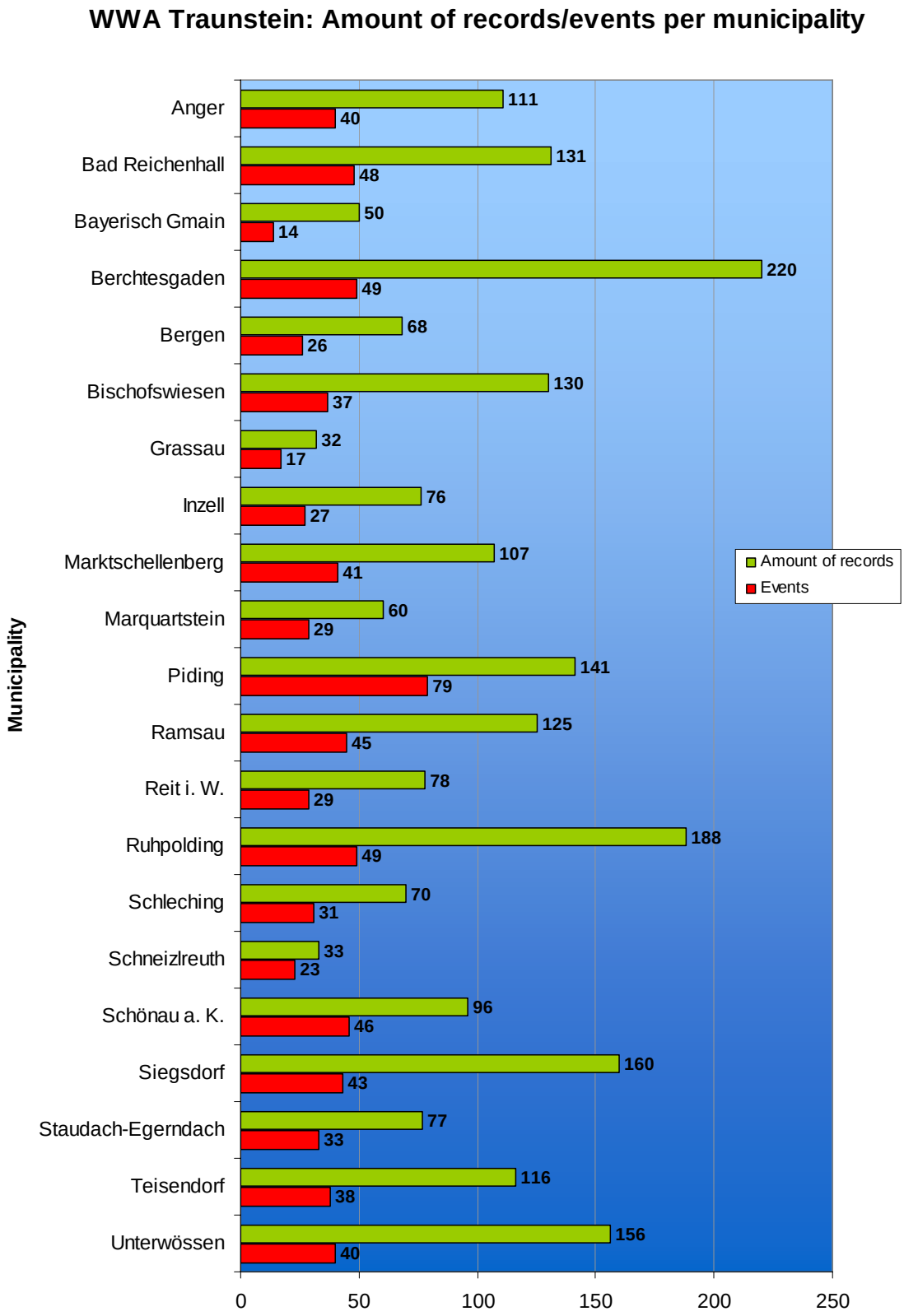


Fig. 10: WWA Traunstein: Amount of records/events per municipality

3.5 Torrents with a High Risk Potential

The majority of hazardous events in the Bavarian Alps occur on a local scale, mostly cause by mountain torrents. Nevertheless there is no general statement about the risk potential of torrents. Therefore it is necessary to take a close look at every single torrent. Fig. 12 to 19 show the most significant torrents ordered by administrative districts. From the illustrations the numbers of different incidents per torrent can be deduced.

However the number of incidents is not evidence enough to estimate the hazardous potential of a mountain torrent. To establish valuable evaluations every single hazardous event must by analysed and rated by its magnitude. The following examples show how floods can be categorised.

Category	**Characteristics**
0: not classifiable	Floods only mentioned; no information on damage
1: swollen torrent	Spating torrent, sometimes overflowing its banks
2: light floods	Damage to structures of flood control
3: moderately severe floods	Damage close to the banks
4: severe floods	Damage to buildings; damage to property
5: catastrophic floods	Vast damage to property; possibly damage to persons

Tab. 1: Categorisation of floods

	Number of events per category									
Torrent (municipality)	0	1	2	3	4	5	Number of events	Number of documents	Documents per event	Oldest document
Weiße Achen (Ber)	1	2	10	4	1	0	18	52	2,89	1875
Steinbach (Ruh)	1	2	5	5	0	1	14	51	3,64	1875
Partnach (G.-P.)	2	3	9	8	5	0	27	31	1,15	1853
Linder (Ett)	9	0	13	11	0	1	34	44	1,29	1893
Leybach (Sont)	0	2	4	3	3	2	14	16	1,14	1819
Kieferbach (Kief)	0	0	6	1	1	0	8	18	2,25	1899
Jenbach (BFei)	1	3	7	6	0	1	18	43	2,39	1200
Hausbach (Weil-S)	7	0	2	2	5	3	19	22	1,16	1626

Tab. 2: Categorisation of sample torrents

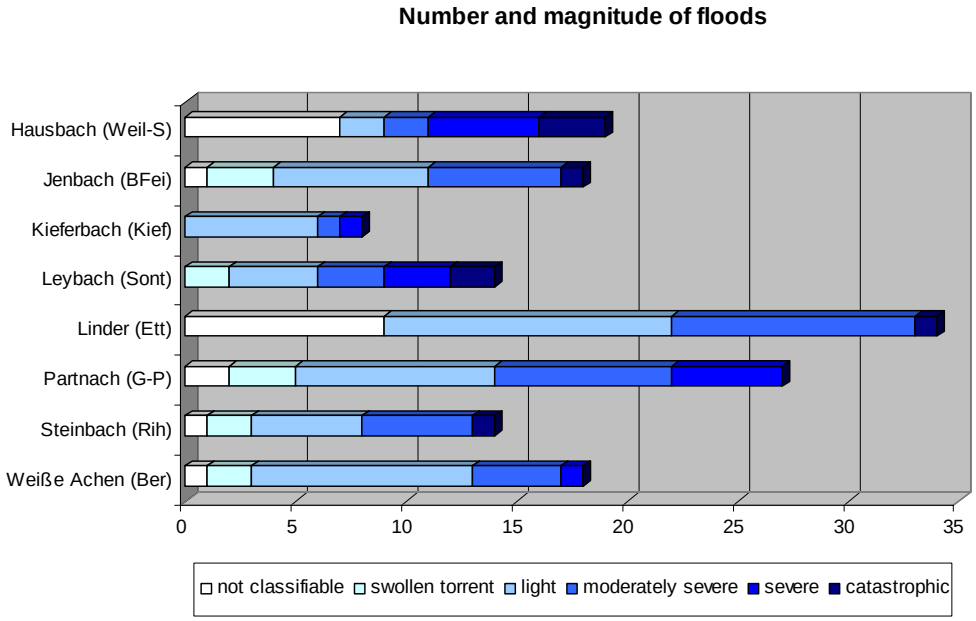


Fig. 11: Number and magnitude of floods

From Tab. 1 and Fig. 11 it can be deduced, that most events cause spating torrents and floods damaging structures of flood control. However all the sample torrents have provoked events with partially significant damage (e.g. buildings). Therefore the collected data allows the assessment of a hazardous potential of these torrents. Nevertheless statements about the frequency of heavy floods can only be made for the past 100 years. For this time span the sources seem to provide consistent information. As an example, the data gives us the information that between 1899 (oldest source) and 1988 there were 8 hazardous floods caused by the Kieferbach torrent (Kiefersfelden), which means one event every 11 years on the average. Most of these events just endangered structures of flood control and areas in the vicinity of the torrent, but there is one “severe flood” indicating its potential as a high risk torrent under certain circumstances.

However, for most torrents a frequency analysis is, at present, merely possible for the past 100 years, since older data is too rare. The Jenbach torrent (Bad Feilnbach) can be taken as an example to illustrate this. For this torrent two references from the years 1200 and 1608 could be detected. Based on the sources these events can be rated as “moderately severe” and even “catastrophic”. Nevertheless further sources are only available from 1924 onwards, but with none of them indicating any more extreme damage. Therefore it is currently not reasonable to make any suggestions about the frequency of incidents at this torrent, since there is an information gap of

more than 300 years. On the other hand the time span from 1924 to the present is too short to completely rule out any further catastrophe. For that reason the acquisition of further information is desirable.

The torrents listed in Tab. 2 are represented by many sources. Even so hazardous events on these torrents are only documented by 2 sources, which also makes it necessary to put any analysis of single events on a wider base of evidence.

4. Future Prospects

The research and analysis of the documents of HAWAS as the subproject of HANG has been finished. At the same time the next step and subproject HAGEM (Historical analysis at the local authorities) was prepared. Basing on the results of HAWAS a priority list of municipalities was compiled in close collaboration with experts of the Regional Agencies for Water Management. These lists contain those municipalities most severely exposed to natural hazards. As the next step of research the archives of the local authorities of the list will be scrutinized to enhance the existing data.

The following aspects can be expected from the contributions of the subproject HAGEM:

- *Specification of detected incidents,* concerning dimension and location by providing more detailed information about those events represented by just few documents. Especially with regard to those places not being localised so far, employees of the local authorities might be a helpful aid for their identification.
- *Extension of the data regarding the time dimension.* As proved in the test stage of HANG, most of the local authorities have information dating back more than 150 years. Such information would be of vital importance to find out exceptionally rare natural disasters.
- *Further information on geological and geomorphologic hazards.* Since the archives of the Regional Agencies for Water Management mainly provided documents on hydrological events it can be expected that other types of hazards are underrepresented in the current data of HANG. According to experience the archives of the local authorities can close these information gaps.
- *Validation of current data:* Historic data always imply the possibility of incorrect information and tradition. The collection of various references of a certain event minimizes this problem.

Appendix

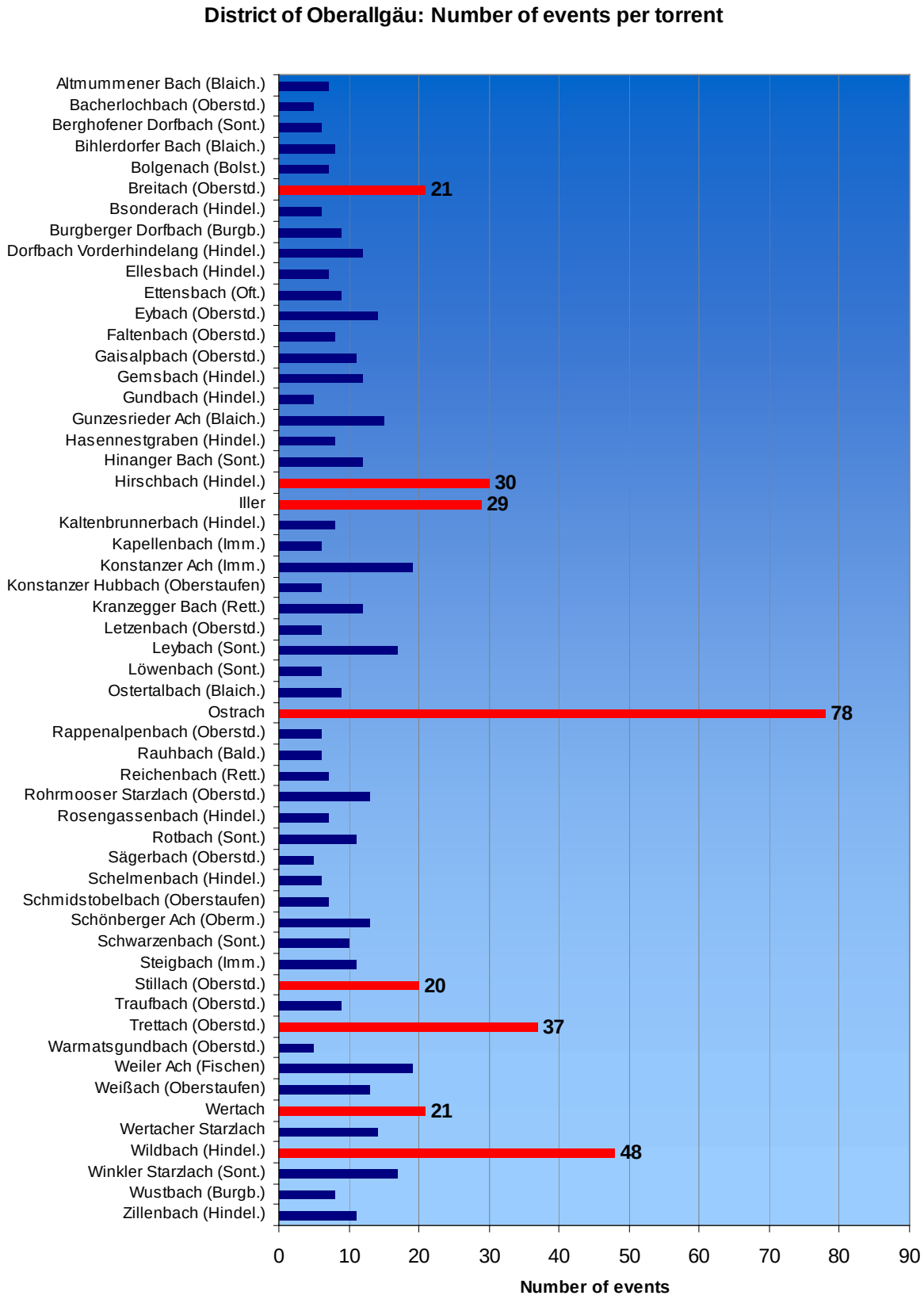


Fig. 12: District of Oberallgäu: Number of events per torrent

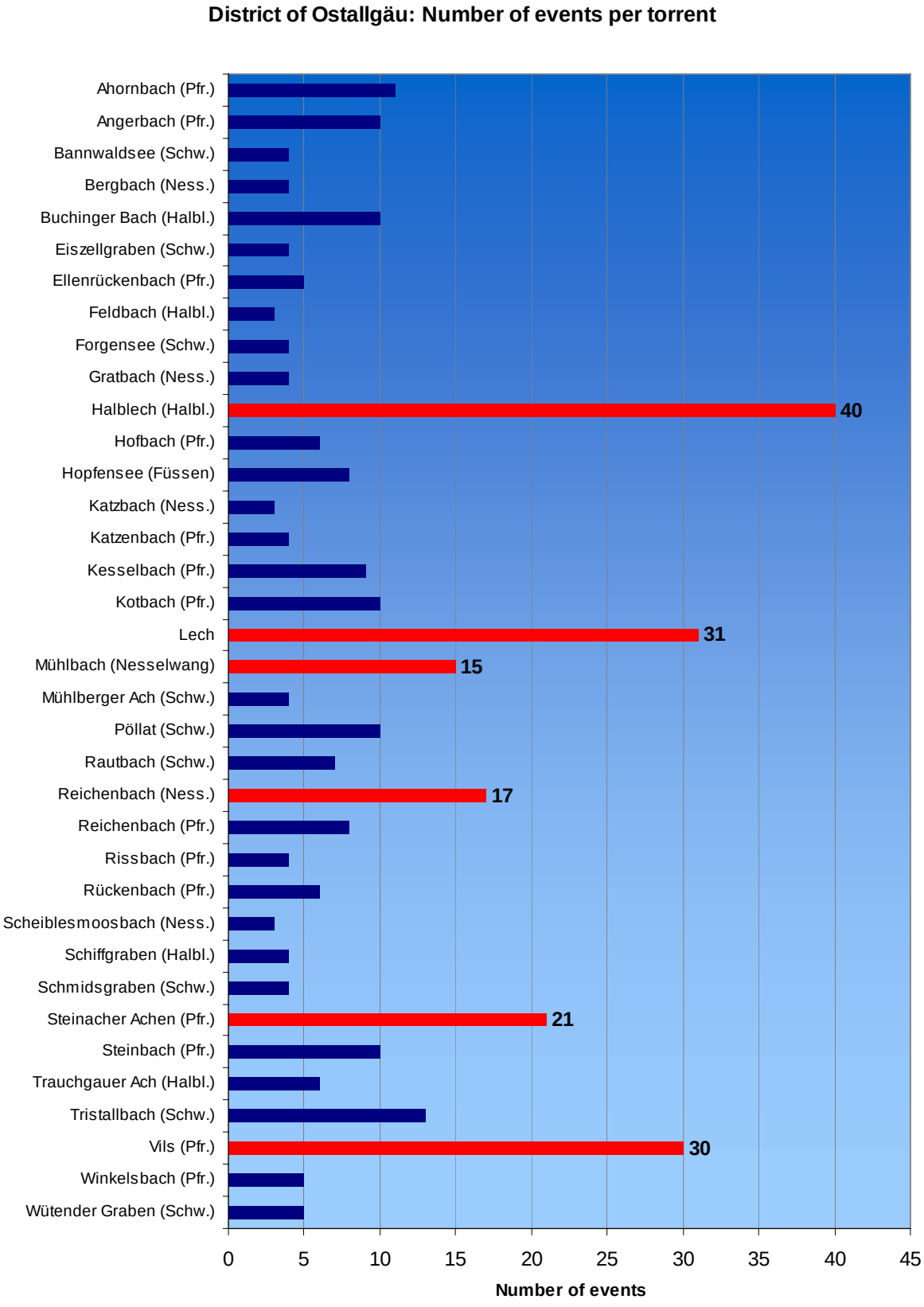


Fig. 13: District of Ostallgäu: Number of events per torrent

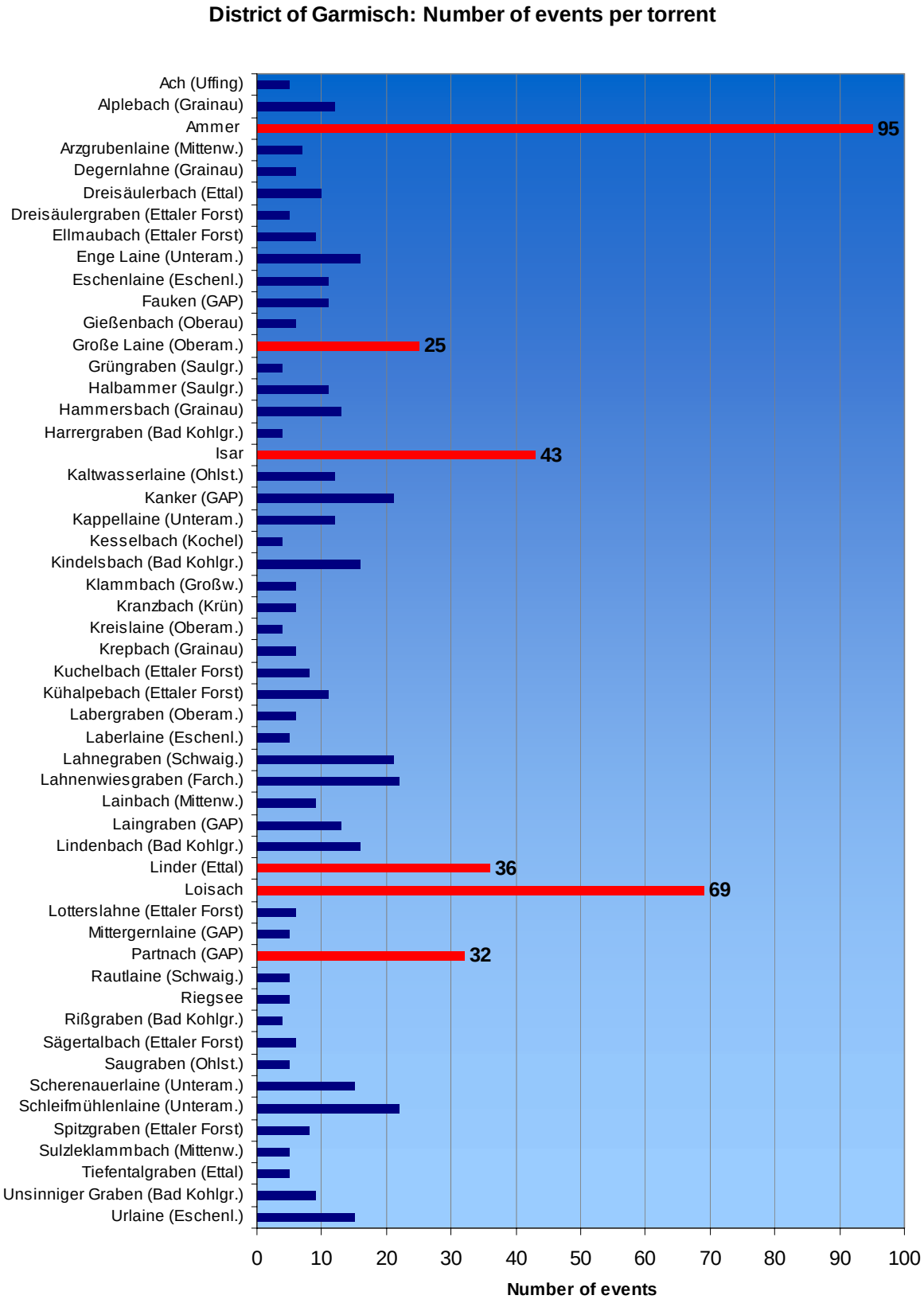


Fig. 14: District of Garmisch: Number of events per torrent

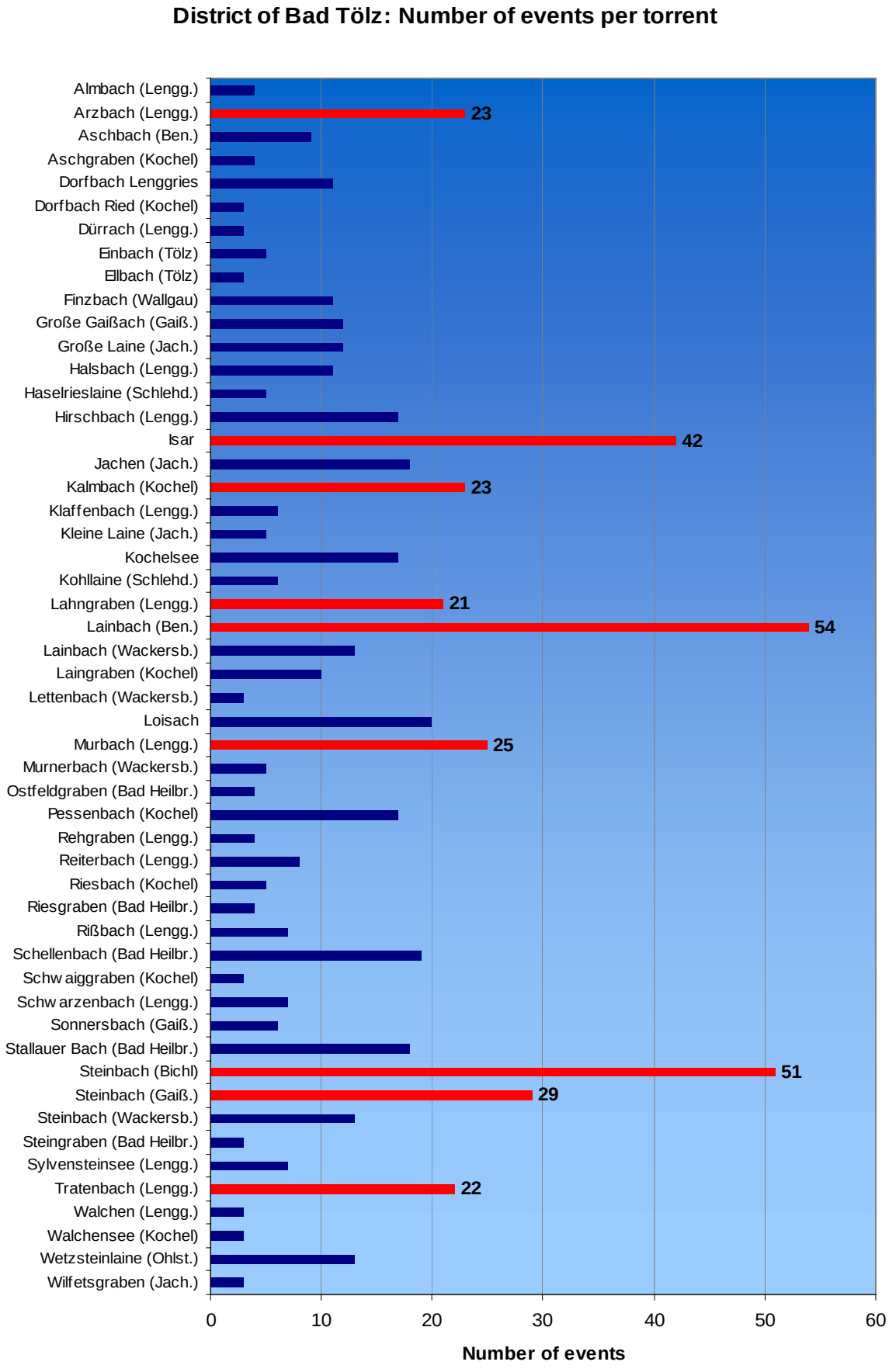


Fig. 15: District of Bad Tölz: Number of events per torrent

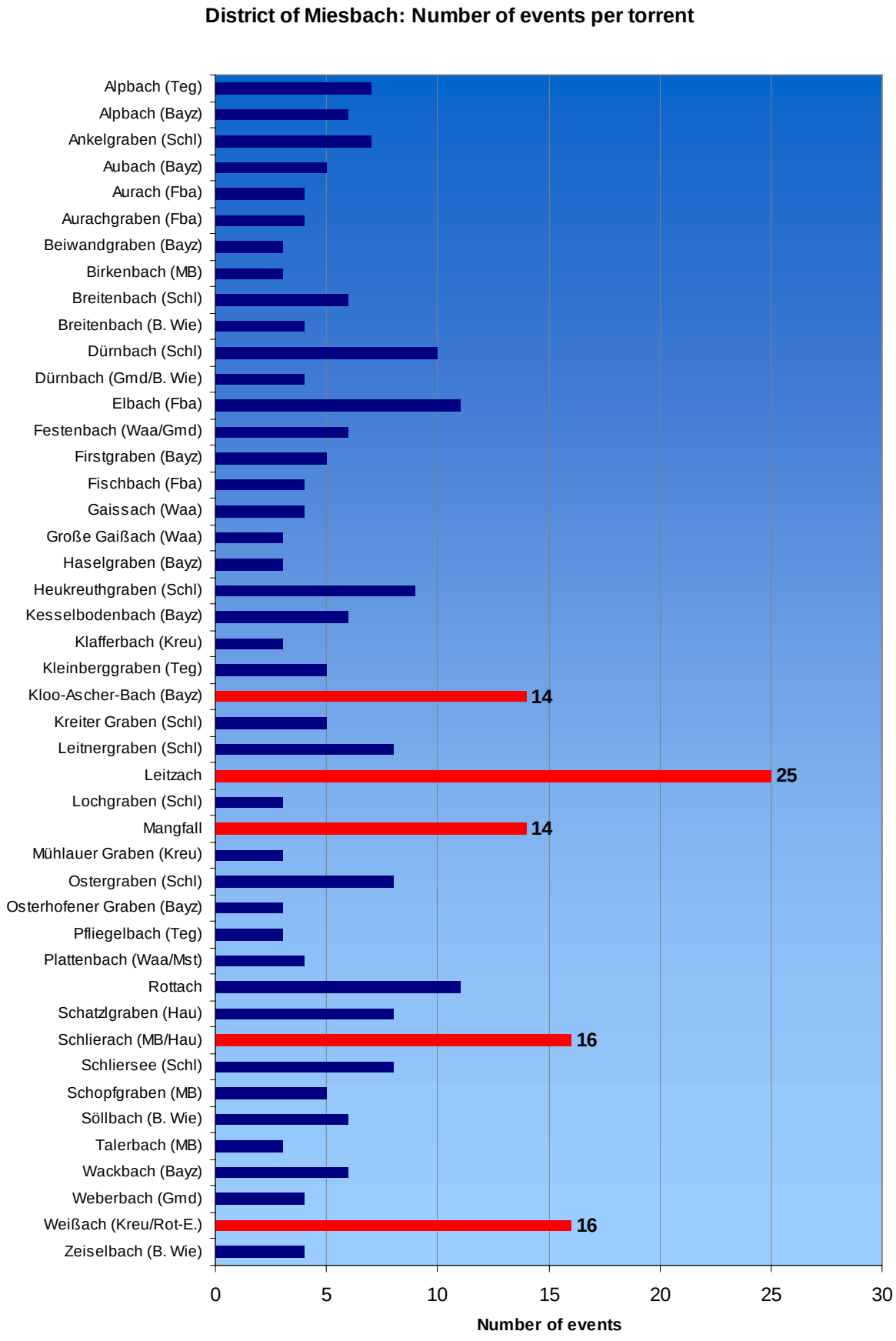


Fig. 16: District of Miesbach: Number of events per torrent

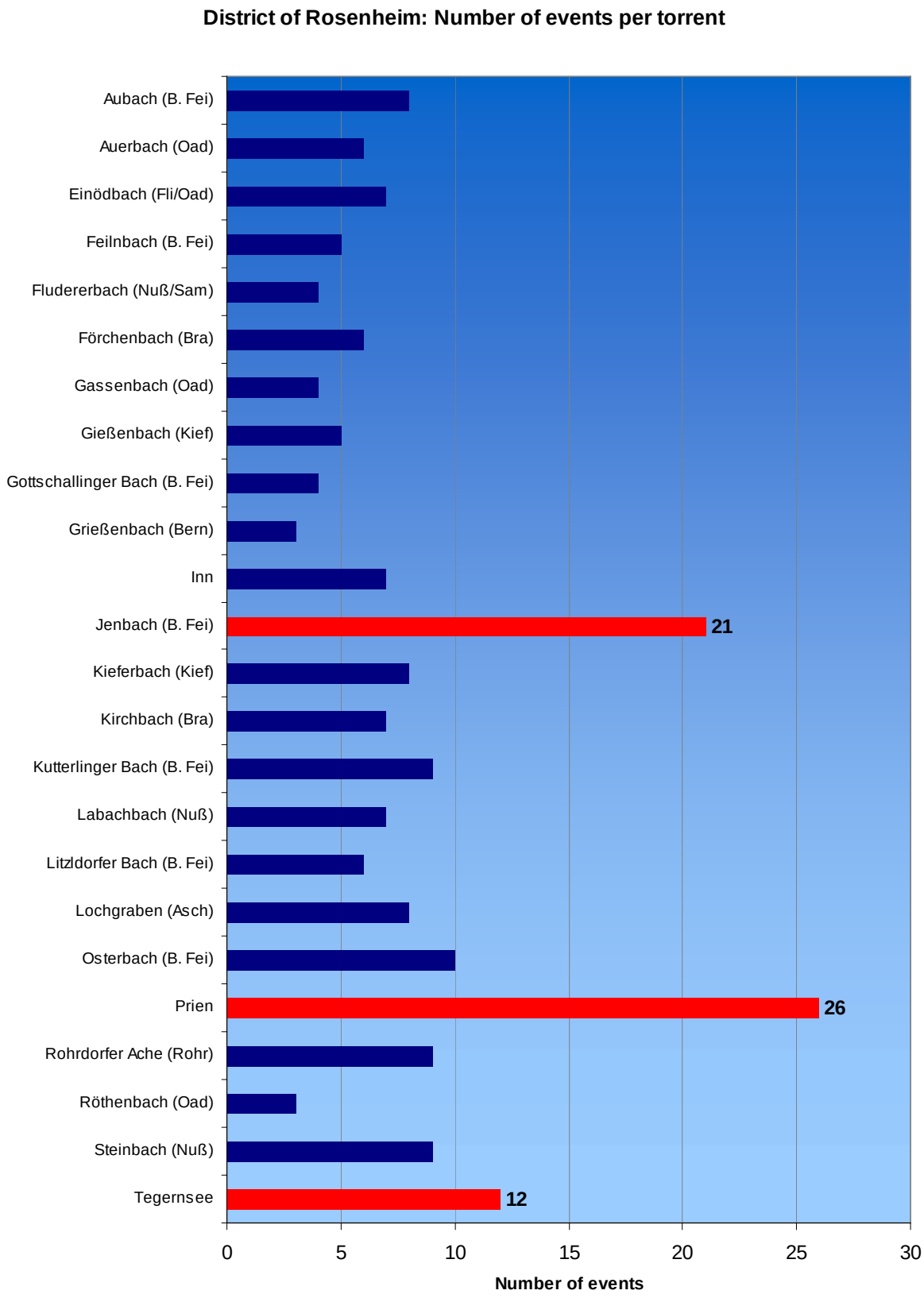


Fig. 17: District of Rosenheim: Number of events per torrent

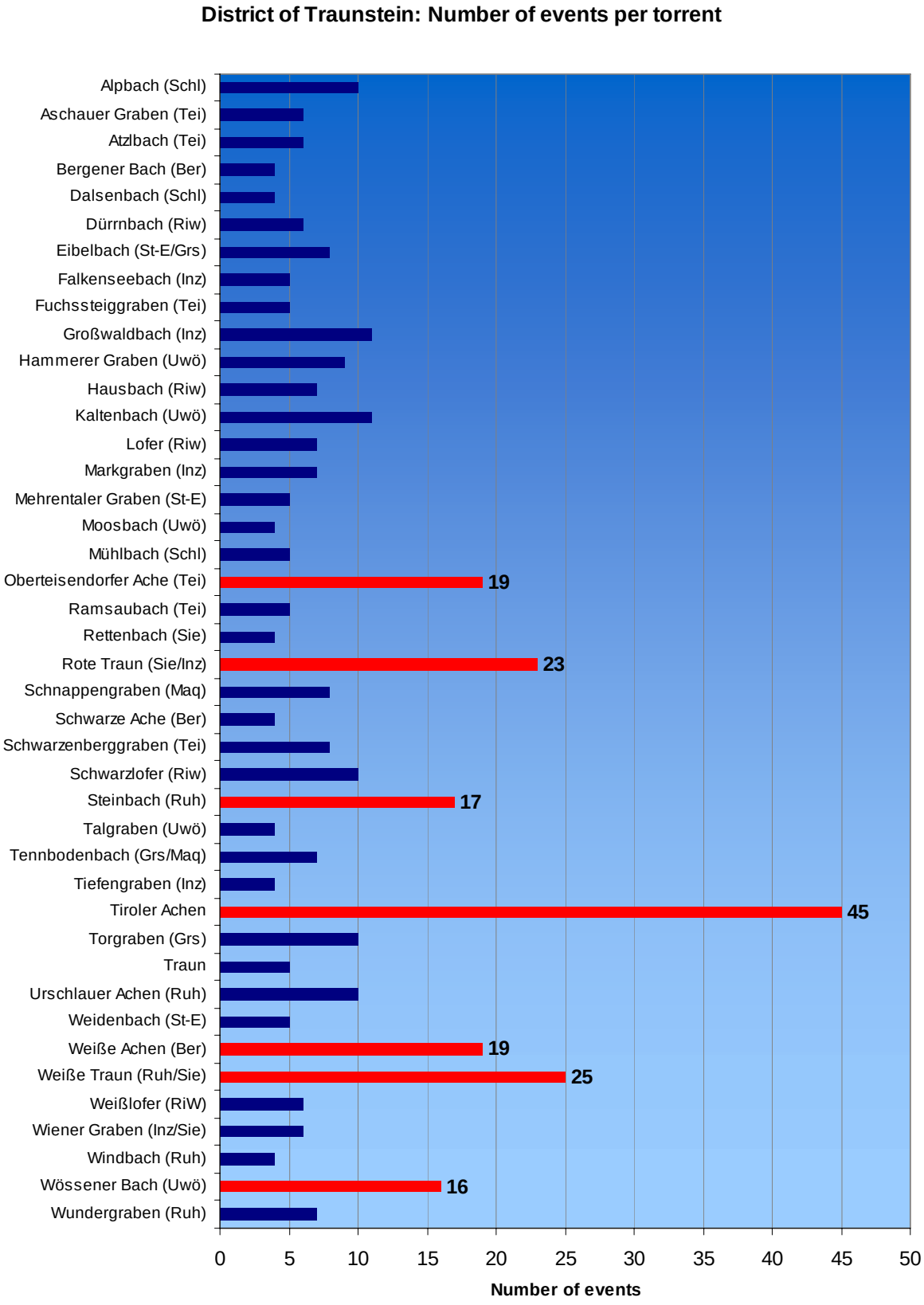


Fig. 18: District of Traunstein: Number of events per torrent

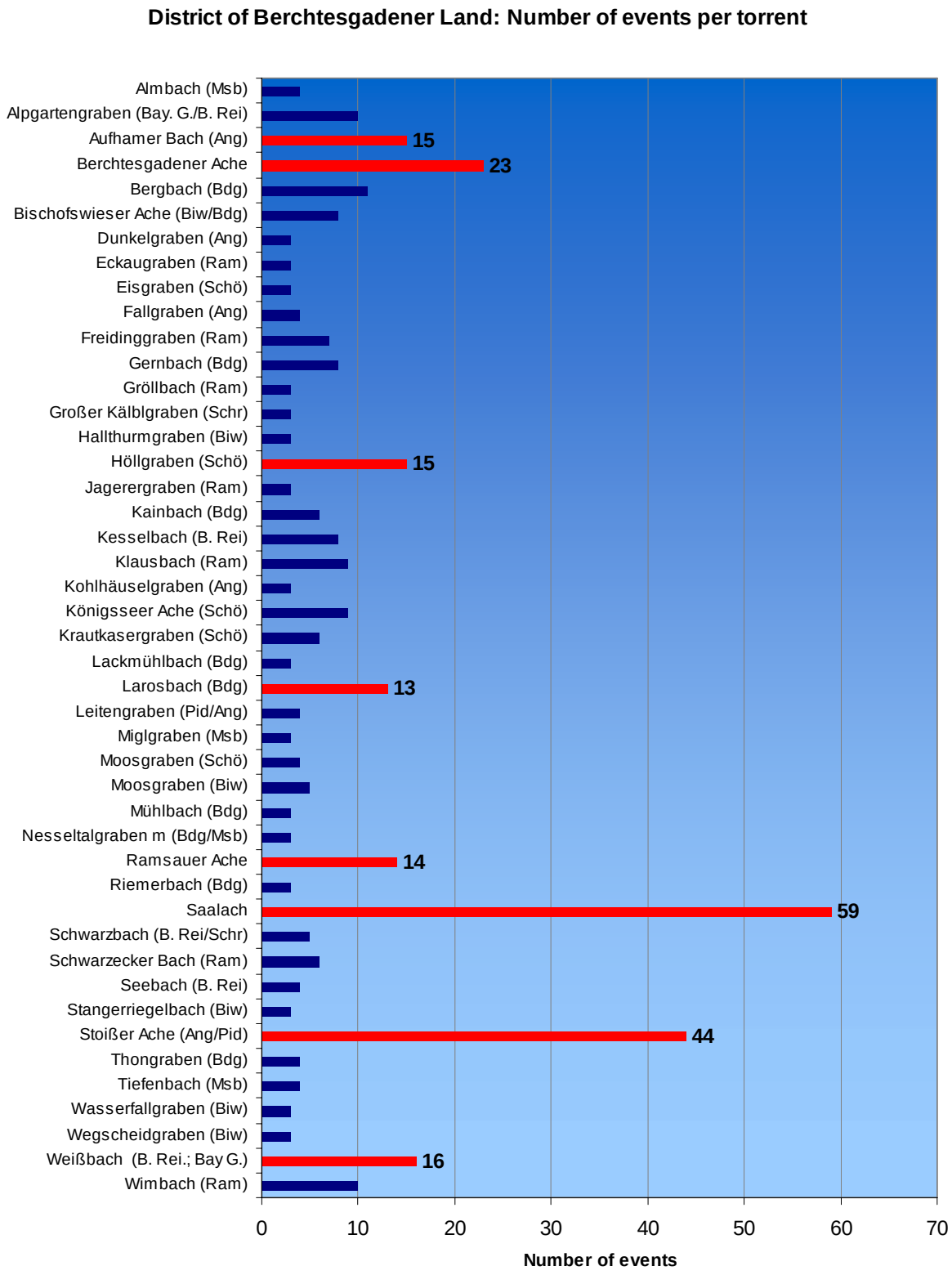


Fig. 19: District of Berchtesgadener Land: Number of events per torrent