

GÉO-GUIDE

GARDONS & GARDONNADES

Understanding floods
and flood risks in the Gardon
river catchment



Discover Collias

- Village walking trail:
1 hour
- Gorges walking trail:
4 hours



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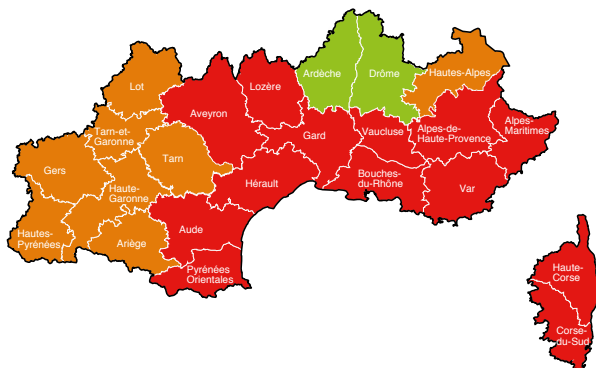
The Inter-regional Mediterranean Arc Flood Unit

This geo-guide was produced with support from the Inter-regional Mediterranean Arc Flood Unit.

The flood unit was created in 2017 by the Prefect for the South Defence and Safety Zone. It covers continental French regions most exposed to torrential flooding, such as Provence-Alpes-Côte d'Azur, Occitanie, Corsica, as well as the Drôme and Ardèche Departments.

The unit reports to the DREAL* PACA which is also the DREAL* branch office here, in the local area.

The flood unit strives to improve the performance of flood risk prevention schemes and ensure that such schemes are applied consistently from zone to zone and within the Mediterranean Arc as a whole. To do this, it works on inter-Ministerial and multi-partnership initiatives that foster synergies between civil protection and risk prevention stakeholders. **The working method used is based on grass-roots approaches to apply the principles, experiment and even innovate, to learn lessons or promote useful guidance for all stakeholders in the Mediterranean Arc.**



Area covered by the Mediterranean Arc Flood Unit

Green Departments belonging to the Mediterranean Arc outside the South Defence and Safety Zone.

Red Departments belonging the Mediterranean Arc within the South Defence and Safety Zone.

Orange Other Departments in the South Defence and Safety Zone also exposed to heavy rainfall and flash floods.

- A glossary, on page 46 explains terms indicated with an asterisk*.



The Gardonnades caught on camera!

You can view videos taken during major flood events, especially those in September 2002.

Simply scan the QR codes with your smartphone or tablet.

Editorials

We often fail to fully appreciate where we live or spend our holidays. Equally, we can neglect local history, the processes at work around us, together with potential dangers among all the qualities that attract us to a place. Yet, these principles are key to being at one with our surroundings and make the most of the local area and the activities on offer. That way, you won't be caught out by known or predictable events in a flood-risk area.

Water has often shaped the landscape in the Mediterranean Arc and influenced land-use. Floods are part of our past and present. They are frequently powerful and destructive yet forge the identity of the catchment areas around us. There's no need to be alarmist about floods but it is best to be realistic. So, let's find out more about them to be better prepared for when they do occur.

This geo-guide, produced by Sudaléa, the EPTB Gardons and the Syndicat Mixte des Gorges du Gardon, invites you to explore the Gardon rivers basin and discover this wonderful area with two great walking trails. You'll find out about the powers of water, past floods and flood risks. We hope you'll enjoy using this geo-guide with your friends and family and that it gives you a new insight into the local area.

We also hope that other stakeholders in the Mediterranean might like a river catchment geo-guide to showcase their own areas too.

Ghislaine Verrhiest-Leblanc
Inter-regional Mediterranean
Arc Flood Project Officer, DREAL* PACA.

The Gardons river catchment is very special given the sheer range of scenery, coupled with outstanding natural and cultural heritage. The area oozes appeal but you have to learn to live with the Gardon and its floods, which are just as impressive. They can exceed 7,000 m³/s, as happened in September 2002, which those who experienced it remember only too well. This geo-guide takes you on a journey of discovery, from the Lozère and Cévennes to the Gardon d'Anduze and Alès river catchments, via the Gardonnenque and its gorges, on to Uzès and the lower Gardon and finally, to where the river joins the Rhône. You'll see how the local people have adapted to "Gardonnades" with infrastructure (the Sainte Cécile d'Andorge and Saint Geniès de Malgoirès dams, the flood barrier at Aramon, and 'tancas' in the Cévennes). You'll see how communities have made themselves less vulnerable by adding cofferdams in doors and gateways or even relocating (the story of Massillan, the village that vanished). Flood markers have been put up to commemorate events and special measures have been introduced to local plans. There are also local emergency action plans and information documents for the general public (DICRIM). Vegetation is now managed and rivers are monitored (Vigicrue system from the Grand Delta Flood Forecasting Service). Activities are organised in local schools, together with exhibitions on different topics for the very young and the general public. There's so much going on and the EPTB Gardons actively contributes to many of these activities.

Max ROUSTAN, President
of the EPTB Gardons and
Bérangère NOGUIER,
President of the Gorges du
Gardon Joint Association.



A few facts about floods

A flood is when water invades land that is normally dry.

Surface runoff at Sagriès in the Uzège district on 10 October 2014.

DDTM* 30

Are Cévenol episodes really Cévenol?

Our Mediterranean regions regularly experience so-called “Cévenol episodes”. These are very heavy downpours based on the amount of water falling in a given time. They commonly occur in late summer and early autumn, resulting in large amounts of rain falling in a short time. For example, a famous record dates back to 29 September 1900 when **950 mm of rain fell in 10 hours** on Valleraugue, at the foot of Mont-Aigoual, i.e. the equivalent of 10 bathtubs of water for every square metre!

By comparison, normal annual rainfall in Nîmes is 762mm. That said, the Mediterranean climate means that this falls over just 64 days, while the monthly average combined from September to January is 428 mm.

Cévenol episodes can be highly localised, as was the case on 8 to 9 September 2002, when a large part of the Gard Department was hit by torrential rain, especially the Gardons catchment area.

Although frequent in the Cévennes, these ‘episodes’ are especially typical of Mediterranean coastal areas, squeezed between the sea and mountains. Recent floods in the Aude on 15 October 2018 and near Cannes on 3 October 2015 are examples of this, but similar events have also recently hit areas in Greece, Spain, Italy and North Africa.

From runoff to a flood, how a climate event develops

Surface runoff is partly due to rainfall intensity and

partly to relief. The steeper the slopes, the greater the runoff speeds.

Soil permeability is an important factor too. Indeed, the geology and types of surfaces in urban areas are crucial. Some rock, like limestone, which forms a large part of the Gardons catchment* can absorb a lot of water, while others, like clays and artificial surfaces (concrete, tarmac and tiles) are sometimes virtually impermeable.

Runoff can spread out to form large pools of surface water or collect in thalwegs*. The water then travels along in permanent streambeds creating a surge in flow*. When this happens, we say the river is on stormflow and above a certain level, the river can overflow from its streambed* into its floodplain*. Just how far the water spreads depends on the surrounding relief.

In both cases (surface runoff or overbank flooding), there’s going to be flooding!

In a given area, the probability of a flood occurring that reaches a specific height and flow rate is called a climate hazard. This hazard can be high, moderate or residual.

From flood hazard to risk!

If this hazard threatens assets like property and human life, economic activities, roads, public services and property, etc. we then refer to a flood risk. The more vulnerable the assets, the greater the risk.

History and floods

“ Gardon , Nyme, eaux
si hault desborderont,
Qu'on cuidera Deucalion
renaistre
Dans le Colosse la
plupart fuiront
Vesta, sepulcre, feu
esteint à paroistre ”

Nostradamus*



Main historical floods



You don't have to be a 'seer' like Nostradamus* to warn people that the waters will rise again sometime. When he lived, in the 16th century, this illustrious Provençal astrologist may have predicted catastrophic floods in Nîmes and along the Gardon River. Perhaps, he was thinking about the flood of 9 September 1557 when he wrote these lines of verse between 1558 and 1563. Maybe it was the flood of September 1551 that swept away an arch of the Pont du Marché bridge in Alès. Who knows?!

What we do know is that the Gardon has burst its banks on many occasions with serious consequences. Records point to dozens major flood events since the Middle Ages.

Although we have few reliable written records prior to the 13th century, a study of sediments deposited by major floods in a karstic cavity* 15 metres above the stream bed* in the Gorges du Gardon, unearthed some surprising findings. It actually found that many extreme flood events occurred at the start of the "Little Ice Age"*, in the 15th century. The study also confirmed that the 2002 flood was one of the most powerful that occurred since this period.

What relics are left in the landscape now?

Seules leurs intensités et leurs conséquences distinguent les inondations les unes des autres et seules les plus Only

their intensity and their consequences distinguish one flood from another. Also, only the more recent floods leave visible marks on the landscape or can be described by witnesses.

You'll often find the relics of floods, From the Cévennes to the Rhône, such as debris lines* in the riparian* buffer zones, where small branches are trapped among the trees.

Flood markers, painted or inscribed on buildings, bear witness to the biggest floods that have left an impression on our friends and families.

These markers were promoted in 2006 by the EPTB* Gardons, (ex-SMAGE* des Gardons), with the addition of 200 new flood markers in line with a new nationwide design.

As a result, the ones that stand out most along the Gardon and its tributaries are the floods of 1907, 1958 and especially the 8 and 9 September 2002, which is never far from people's thoughts due to its scale and devastating effects.

This geo-guide focuses mainly on these three floods but also features more recent events in 2014 and 2015, as well as the oldest-known flood, dating back to 1403 which wiped out the village of Massillan in the Gardonnenque district (see page 13).



Flood markers installed by the EPTB* Gardons, in Rue Pélico, in Anduze.



The Gardons river catchment: Physical and human features

The catchment area*

A catchment area contains a complex drainage network and the Gardons river catchment covers more than 2000 km² with 150 towns and villages. About 180,000 people live in the area, more than half in the town of Alès.

The catchment is very varied. There are several areas and sub-catchments. These are the Cévennes containing the Gardons d'Alès and Anduze rivers, the Gardonnenque, the gorges du Gardon, the Uzège and the Lower Gardon.

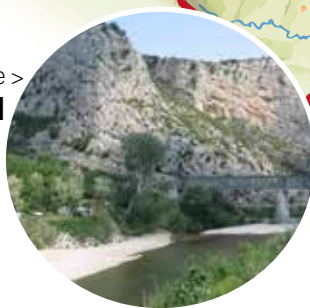
THE GARDON D'ALÈS RIVER CATCHMENT

Alès >



Upstream from Anduze >

THE GARDON D'ANDUZE RIVER CATCHMENT



Gard, Gardon or Gardons?

The original term for river comes from the early Latin word, Vardo. Although the meaning of Vardo remains unclear, it gave rise to the word, Gard, which was the name chosen in 1791 when the Departments of France were created.

That said, people have long referred to the "Gardon" and "Gardons", as featured on a 17th century map and in Nostradamus' quatrains*. Indeed, those living along the river's lower reaches call its upper tributaries the "Gardon", which means "Small Gard".

If you break down the tributaries into their geographical origins, you get the Gardons d'Alès, d'Anduze, de Mialet, de Ste-Croix, de St-Martin and de St Germain rivers. The name "Gardon" subsequently became commonly used to refer to all the water courses along the river until it joins the Rhône.

LA GARDONNENQUE

Moussac



THE UZEGE

The River Alzon, in the Eure Valley, at Uzès



THE GORGES

The gorges at Sanilhac



THE LOWER GARDON

The Seuil de Remoulins watershed



- 01 The Gardon d'Alès
- 02 The Gardon (official source)
- 03 The Dourdon
- 04 The Grabieux
- 05 The Galeizon
- 06 The Salandre
- 07 The Avène
- 08 The Gardon de St-Jean
- 9 The Gardon de Ste-Croix
- 10 The Gardon de St-Martin
- 11 The Gardon de St-Germain
- 12 The Gardon de Mialet
- 13 The Salindrenque
- 14 The Amous
- 15 The Gardon d'Anduze
- 16 The Droude
- 17 The Esquielle
- 18 The Braune
- 19 The Ruisseau de Vallongue
- 20 The Goutajon
- 21 The Bourdic
- 22 The Seynes
- 23 The Alzon
- 24 The Valliguiere
- 25 The Briançon



The Gardon d'Alès river catchment

The Gardon River, at Alès.

The Gardon d'Alès River starts in the southern foothills of the Montagne du Bougès, in Lozère. It then descends through thalwegs* and streams (valats*) which join to form the river. This collection of small mountain streams, the highest of which begins at 1,350 m, below the Signal de Ventalon peak, rush down the short but very steep slopes. After only 15 km, the Gardon d'Alès is just 285 m above sea level, at Collet de Dèze.

This steeply sloping land causes sudden torrential, sometimes extremely rapid, stormflows.

This torrential character quickly disappears when it reaches the piedmont* of the Cévennes that the river encounters just upstream of Alès.

Before it flows into the Gardon d'Anduze, between Vézénobres and Cassagnoles, the river is joined by several large tributaries on its right bank, such as the Galeizon (certified as a "river in good condition"* and "wild river"*), the Alzon (not to be confused with the other River Alzon, in Uzège) and the Carriol.

On its left bank, tributaries like the Grabieux join it at Alès, followed by the Avène.



Tragic floods in 1605!

Alès experienced one of the deadliest floods in the history of the Gardons river catchment. On 10 August 1605, the Gardon burst its banks and devastated the town. It hadn't rained in Alès, so there must have been a very violent storm upstream.

Potamologist*, Maurice Pardé* noted:

"On 10 August, many people died in Alès when it was flooded by the Gardon. 40 residents perished when the ramparts collapsed, weakened by the strong currents. Five or six others clung to willow trees for





EPTB des Gardons



The Sainte Cécile d'Andorge dam

The impressive Sainte Cécile d'Andorge dam, between Le Collet de Dèze and La Grand-Combe, is flood retention dam* built in 1967 after devastating floods in 1958. It retains all or part of the water flowing from the upper catchment to protect life and property downstream, especially the town of Alès. Its efficiency depends on how rainfall is distributed over the Gardons river catchments and affect nearby areas downstream. It has a reservoir to replenish river baseflow*.

The dam is managed by the Gard Departmental Council, which operates and maintains it.

At the foot of the dam is a second one, the Barrage des Cambous, built in 1955 to supply the mining industry with electricity. Nowadays, it is mainly used for leisure purposes.



Département du Gard

Sainte Cécile d'Andorge Dam.

two to three hours, calling for help, separated from the townsfolk who yelled to them sorrowfully from the walls. Seeing that no help was at hand, they prayed to god and prepared for a quick death as the trees fell and were washed away by the powerful current. Just one person miraculously escaped.”



The Grabieux, a high-risk tributary!

Fed by its tributaries, the Bruèges, the Ruisseau Blanc and the Ruisseau Rouge, the Grabieux joins the Gardon right in the centre of Alès, at the Prés St-Jean.

This small river has a torrential flow regime* and quickly descends towards the town from the hills rising above St Julien-les-Rosiers. It flows through densely built-up urban areas (housing estates, flats, shops and businesses, public services and roads, etc.). As a result, you are in an area with an exceptionally high flood risk. What's more, numerous crossings (footbridges, road bridges and a railway viaduct) complicate the situation by generating log-jams*.

On 8 and 9 September 2002, and again, on 19 and 20 September 2014, some districts, like Les Tamaris, as well as Le Moulinet and Les Prés St-Jean downstream, where the Grabieux joins the Gardon, suffered greatly from these floods, though fortunately without loss of life.

To deal with these events, the local residents formed their own association, "Sinistrés du Grabieux 2002, 2014" in spring 2015 with more than 170 members.

However, in September 2015, the wayward Grabieux once again suddenly flooded certain houses.

As a result, the residents' association is currently involved in considering its options, together with Alès Agglomération and l'EPTB* des Gardons.

A similar association was also created following the 1933 flood in Alès.

Debris dams on a footbridge and damage following a flood by the Grabieux on 20 September 2014.



Check valves

Water can flood part of the floodplain without overflowing by simply flowing back up the rainwater drainage pipes. To prevent this, anti-flood check valves are fitted to pipe outlets, like the one you can see at the foot of the Pont-Vieux bridge, on the right bank of the Gardon, at Alès.



Look at the pictures of the 2002 flood that hit the districts of Les Tamaris, Le Moulinet and Les Prés St-Jean.

The ground floors of the flats in Les Prés St Jean have been condemned since the flood.



The Gardon d'Anduze catchment

The Gardon de St-Jean, at Peyrolles.



A gathering of Gardons!

Just like the Gardon d'Alès river catchment, the landscape in the Gardon d'Anduze catchment is very steep, both up and downstream.

There are a great many gullies, or valats*, upstream of Anduze, as well as streams that rush down the steeply sloping hills from the Cévennes. They start at the foot of a natural amphitheatre of mountain peaks, 1,000 m high (1,225 metres on the foot slopes of Mont Aigoual). Most of these temporary and torrential regime* water courses flow from the Lozère forming a gathering of Gardons.

So, let's now journey upstream from Anduze to see which Gardon is which. In fact, just after the town and where the Amous River meets the river, the Gardon de St Jean (du Gard) and the Gardon de Mialet join to form the Gardon d'Anduze. The Gardon de St Jean is sometimes called the Gardon

de St-André (de Valborgne) in its upper reaches.

The Gardon de St Jean has carved out spectacular gorges at Peyrolles before being joined by the Salindrenque after flowing through St-Jean-du-Gard. As for the Gardon de Mialet, it starts life where the Gardon de Ste Croix (a certified "river in good condition"*) which drains the Vallée Française, and the Gardon de St Martin (de Lansuscle), meet. By now, it has also been supplemented by water from the Gardon de St Germain (de Calberte).

Downstream of Anduze, you're in the piedmont* where the land is much flatter. The river spreads out over a vast alluvial plain all the way to where it joins the Gardon d'Alès.

As a result, the river's torrential regime* is much-reduced.



Wonderful water heritage!

The landscape of the upper Cévennes valleys stems from a long history in which people completely transformed the slopes, virtually as far as the mountain tops.

This change was building terraces, called “faysses”, held in place by dry stone walls. They were made to boost land that could be farmed at a time when the local population was much higher than now. The locals planted sweet chestnut trees in the 17th century, followed by mulberry trees for sericulture* in the 18th century, which led to terraces being built throughout the Cévennes. Deforestation linked to the growth of the mining industry intensified this process.

Sets of dams were built in gullies (valats*) to overcome low water levels and to combat soil erosion. Spruce woods, for example, diverted water for irrigation and tancas limited erosion by protecting the terraces located immediately upstream. While terraces were mainly built on the upper slopes of thalwegs* they were too far away to reduce serious flooding in the valleys.

That said, this was never their purpose!

From the mid-19th century, farming declined in these areas and the rural exodus left many of these terraces abandoned to be reclaimed by the forest. The Maritime Pine, in particular, flourished.

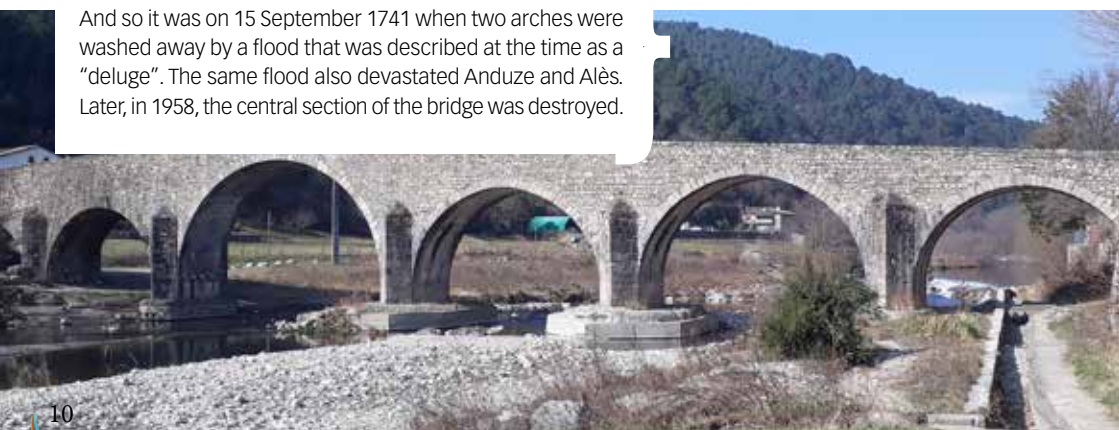
This water heritage, which is especially evident around St-Jean-du-Gard, is sometimes the focus of restoration projects and is very well-described at the Maison de l'Eau in the Borgne Valley, at Plantiers.



An impressive tanca in a thalweg*, near Peyrolles.

Despite its design to withstand floods (reverse V-shape and pillars reinforced with ‘noses’), the amazing Pont-Vieux bridge at **St-Jean-du-Gard** sometimes succumbed to the torrents.

And so it was on 15 September 1741 when two arches were washed away by a flood that was described at the time as a “deluge”. The same flood also devastated Anduze and Alès. Later, in 1958, the central section of the bridge was destroyed.



“ In 2002, the Gardon came in the morning and was already home by the afternoon »
Jacques Bourjas, ex-Mayor of Cardet ”

In Anduze, meanwhile, the town was still prone to countless flash floods.

A small interpretation panel (between the Tour de l'Horloge and the Gardon) gives you an insight into the history of the flood wall. The wall was built after the flood of 4 October 1768 which swept away an arch of the bridge (before the current one) and part of a second. The lower town was flooded and a row of houses on the Rue Basse was then demolished to build the wall.

You can see two flood markers (1958 and 2002) on the clock tower (Tour de l'Horloge) and the Town Hall, but you have to walk to the Rue Pelico to see other markers from less well-known floods.

11 October 1861: A major flood caused 3 houses to collapse in broad daylight and badly damaged the abattoir. People may also have died too.

21 September 1890: The Gard rose to 7.1 m during the night, at the bridge, and damaged the flood wall.

20 to 22 October 1891: Storms on 7 and 12 of October had severely damaged the road network and this continued on the 20 to 22 October.

At Cardet, downstream on the right bank, the rising river waters washed away the school wall.

31 October 1937: In the night of 31 October to 1 November, torrential rain fell on the Gardons causing lots of damage to farmland and the roads.

At St Jean-du-Gard, the chestnut harvest was severely hit. The flood waters were limited at Anduze but the Gardon d'Alès reached its 1907 level at Salles du Gardon.

See pages 23 and 24 for the 1907, 1958 and 2002 floods.

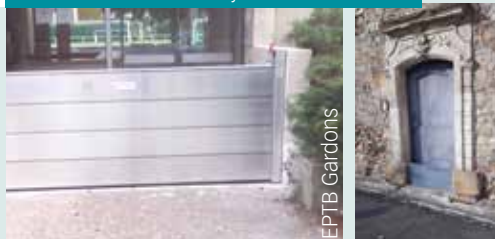
The dam that fell through!

As with the Gardon d'Alès, plans were made to build a flood retention dam* after the floods of 1958. It was to be built at a place called “La Borie” on the Gardon de Mialet. After years of studies and hesitation, the project finally took shape in the 1980s. This sparked huge protests among the local population with many events organised to resist the plan. Some protests even recalled the deadly revolt by the Camisards* at the start of the 18th century. Finally, after much debate, both locally and in Paris, the plan was abandoned in the early 1990s.

Cofferdams* at Cardet!

This peaceful village, downstream from Anduze, in the piedmont, has been flooded by the Gardon many times, albeit briefly. Many of the houses are protected from flood waters by cofferdams* and/or raised ground floors. The municipality has also fitted larger versions to its buildings (town hall, library and school).

Metal cofferdams* at Foyer de Cardet.



And an older wooden one at the Place du Château.

The Gardonnenque

The Gardon reunited at Cassagnoles.

The Gardonnenque catchment extends from the confluence of the Gardons d'Anduze and d'Alès to the start of the gorges at Russan (part of St Anastasie). The land flattens out here and the Gardon's floodplain* widens considerably. It passes by numerous towns and villages, such as Ners, with its famous iron bridge, Cruviers-Lascours, Brignon, Moussac, Boucoiran-et-Nozières, Sauzet, St Chaptes, La Calmette and Dions. Many tributaries also flow into the river along this stretch.

For example, on the left bank, there's the Droude, which flows from Mont Bouquet at St Just-et-Vacquières, then there's the Bourdic which flows down the Uzège and joins the Gardon just before the gorges. On the right bank a network of several water courses converge on Dions and the Gardon at the same point as the Bourdic. The largest of them, the Braune, from St Mamert, is fed by the Ruisseau de Vallongue (which flows to Nîmes), the Esquielle (and its tributary, the Rouvegade), followed by the Goutajon.

Massillan, a village submerged!

North of La Calmette, between l'Esquielle, l'Habitarelle-de-la-Calmette and the Gardon, the place called "**Massillan**" is all that remains of a village abandoned in the 15th century by its residents after a big flood. In fact, Massillan was probably abandoned after the flood of September 1403 which ravaged the village, leaving local people to find refuge in neighbouring settlements.



St Geniès-de-Malgoirès dam

On the 8 and 9 of September 2002, the village of St Geniès-de-Malgoirès was badly hit when the Esquielle flooded on two consecutive occasions. You can see the flood markers in the village that bear witness to them.



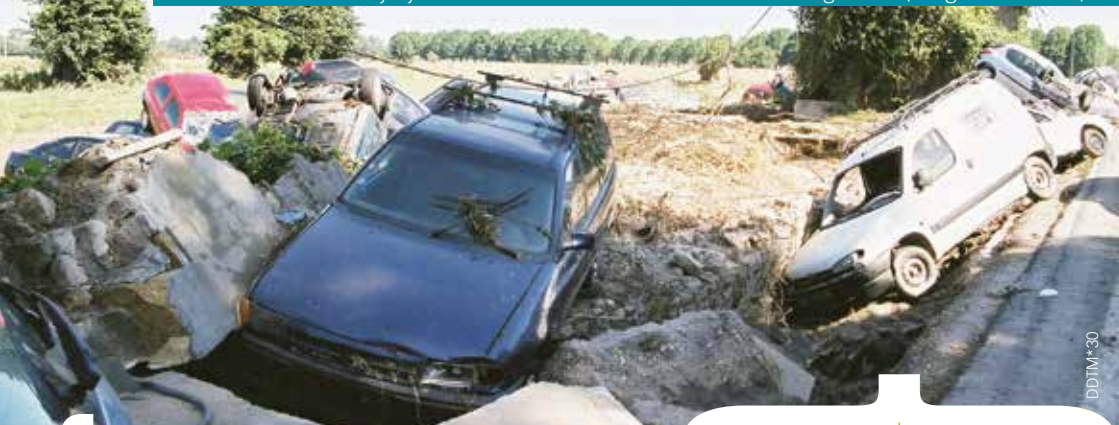
The St Geniès dam.

In 2010, the EPTB* Gardons built a dam to retain* flood waters from the river. You can't miss it if you take the RD 124 road to Mauressargues. A large sign on the roadside describes the dam's dimensions and capacity. 14 m high and 210 m wide, it holds up to 800,000 m³ of water in a 17 ha reservoir.

The size of its spillway* is equally impressive.

The dam stops smaller overbank flood events and alleviates larger floods in the village.





Motorists, beware!

More than 500 years later, this section of the Gardonnenque once again became the epicentre of a dramatic event caused by a major flood which many people vividly remember; the flood of 30 September 1958.

Dozens of vehicles were using the current RD 936 (RN 106 at the time) when the Ners bridge collapsed plunging them into the river. 18 of the 25 people who died that day in the Gardonnenque were motorists.

The RN 106 was subsequently rerouted and rebuilt further above the river, out of reach of the Gardon flood waters and its tributaries such as the Braune and the Esquielle. It's now the main road between Nîmes and Alès.

The old RN 106 became the D 936 and if you drive along it you'll also still see many flood markers of the 1958 flood. Sometimes, you'll also see plaques marking the flood on the 4 October that same year, just like on one of the towers of a large building on the roadside at Habitarrelle-de-la-Calmette.

There's a flood marker from 2002 on the building too. That year, once again, many motorists were trapped by the flood waters. Some vehicles were washed away and dumped in fields tens or even hundreds of metres from the road!

Submersible bridges

Another serious hazard for motorists is crossing submersible bridges. There are dozens of them in the Gardons river catchment* but the bridge at Dions is one of the biggest.

Low and without railings to let fast-flowing flood waters flow over it freely, the road surface is quickly submerged. Did you know that sometimes it only takes a few centimetres of fast flowing water to wash away a heavy car!

Never try to cross submersible bridges when flood alerts are issued and always obey access restrictions to bridges in flood conditions!

Dions submersible bridge.



The gorges

Source in the gorges.

At Russan, the Gardon plunges into a narrow bottleneck, hemmed in by steep limestone escarpments extending for some 20 km. Any flood water rushing into this canyon will have a dual-effect on the river's flow*. Upstream, the entrance to the gorges, produces a flood retention basin* by blocking part of the flood-wave while further downstream, in the gorges, the height and speed of the water will rise. Finally, the gorges cut through a limestone karstic* massif. This will completely transform the way the Gardon flows, both at baseflow or stormflow. We'll look at this in more detail on page 39.



EPTB Gardons

A gigantic, natural flood retention basin*

When the Gardon reaches stormflow, the flood waters are blocked by the narrow gorges and only part of it can pass through. As a result, water levels rise upstream and its flood extent* spreads out considerably. Water levels, even far from the stream bed, are huge.

The 1907 (red line) and 1958 (green line) flood-level markers on the towers of the building alongside the Braune, at Dions show just how high they rise. This tributary also exacerbates things by increasing river flow* rates locally. The EPTB des Gardons has relocated these markers to a roadside electricity pylon near the tower in the direction of La Calmette.

In 2002, the situation was even worse. The water reached the ball on the top of the tower but to get a better idea, walk back up the Rue du Gardon from the RD 22.

You'll find a flood marker just down from the town hall, while at Russan, you just have to stand in front of the church!

The 1907 and 1958 flood markers at Dions.



The Gardon, in normal conditions, at Pont de Russan.



The Gardon at Pont de Russan, on 9 September 2002. The flood waters were much higher.



St Nicolas bridge, partly washed away by the 2002 flood.

Photo: Jean-Pierre Mèger

St Nicolas bridge

This famous 13th century bridge in the Gorges du Gardon was actually altered and raised higher in the 19th century.

As the Gardon's floodplain narrows considerably, the flood waters and flow rates rise sharply. At this point, the river takes on a torrential regime* which it lost when it left the Cévennes.

The river's competence* also rises substantially.

The 2002 flood was no exception and washed away the entire superstructure of the bridge. The force of the water loaded with large debris struck the bridge with huge power and left it in a pitiful state. The repair work was extensive and very costly.

An impressive flood marker attached to a boulder on the right bank after the bridge demonstrates the incredible height this flood reached.

Another much more ancient disaster occurred in 1533, when two mills lying upstream and below the bridge were washed away.

St Nicolas bridge

before it was rebuilt in 1860.

Source: Guilhem Fabre and
Jean Pey "Le Gardon et ses
Gorges", Les Presses du
Languedoc



The Uzège

La Capelle Lake, at the source of the Alzon River.



The Uzège, or district of Uzès, lies on the Gardon's left bank, after the gorges. This area covers the Alzon River catchment together with its main tributary, the Seynes. It's here in Uzès, that water was channelled to supply the Gallo-Roman city of Nîmes, via the Pont du Gard. The Fontaine d'Eure spring where this water was collected has left us a few relics of its past. The source of the Alzon is just upstream from the superb La Capelle-et-Masmolène lake, which is a wonderful oasis in an arid landscape. Its rich and varied flora and fauna have earned it the status of a European Natura 2000* reserve.

There have been many major floods of the Alzon that have caused extensive damage all on its own. One example was in 2002, at Pont des Charrettes when the Haribo sweet factory was severely damaged. You can find flood markers from the 2002 Seynes flood at Serviers-et-Labaume.

The Alzon joins the Gardon at Collias where it has also caused a great deal of damage (see p 30 and 31).

Bourdic and spring floods

Although the Bourdic River is part of the Gardonnenque catchment, it is a feature of the Uzège landscape and, indeed, town hall of the village named Bourdic too, features two surprising flood markers related to it.

The first concerns a flood in June 1915 and reminds us that floods don't always occur in the autumn. The second commemorates a flood in 1943 that was thought to have occurred in September. That said, there is no record of a flood in that month so, given the doubts, the EPTB Gardons chose only to state the year of the flood on new markers fixed to the wall on the other side of the town hall.



1915 and 1943 flood markers on the town hall in Bourdic, complete with a big spelling mistake!

“

Sometimes it's the Alzon that drives the Gardon

Georgette Grazioli,
resident in Collias.

”





More floods in 2014!

Just as in Alès, the floods of September and October 2014 severely affected the Uzège, as we can see in this photo of a river bank being scoured* away and endangering a house at Sanilhac.

Scouring* riverbanks made of soft rocks can seriously undermine building foundations, although various protection measures, such as gabions* are now possible.

2014 was a particularly tough year for South East



Collias, 10 October 2014.

France. In January, the Var flooded badly once again, as it had done in 2010 et 2011. In June, the area of Grasse was hit and in September and November, a series of 'Mediterranean Episodes' targeted the Gard (especially 16 to 20 September and 9 to 10 October), the Hérault, the Alpes-Maritimes (again), the Aude and finally the Pyrénées-Orientales. It was a reminder, albeit to a lesser extent, of the sequence of floods in 1907 (see page 23).



The Lower Gardon

The confluence of the Rhône (with a dam) and the Gardon at Vallabrègues.



Leaving the gorges behind, the Gardon now reaches the Pont du Gard. This famous, UNESCO World Heritage-listed bridge has certainly seen many floods in its time but it has always resisted even the most extreme onslaughts thanks to the addition of a road bridge at its feet, built in the 18th century by an engineer from Aramon called Henri Pitot*. At Remoulins, the Gardon's riverbed narrows briefly once again before expanding all the way to the Rhône, at Vallabrègues. Two final tributaries join the Gardon on its left bank (La Valliguère, just after Remoulins and the Briançon which flows through Théziers). After skirting Montfrin then Comps, it finally flows into the Rhône. The confluence at Vallabrègues was completely reconfigured in 1970, when the Southern Rhône was canalised by the CNR* for shipping, electricity and irrigation. Previous to these works, the Gardon rambled gently across a plain before joining the Rhône, but the 20th century engineering work squeezed the river between two enormous dykes at Comps, reducing its floodplain* to just a few hundred metres in width.



The confluence in 1950.



The confluence today.

Crédit : géoportail.gouv.fr



Remoulins

Remoulins is the last large town on the Gardon's route before it meets the Rhône. The town has some interesting features related to the river, primarily its bridges. You can still see the pillars of a 19th century suspension bridge and listed monument on the riverbank. It was replaced by a new bridge in 1936, although this one was damaged in the 1958 flood when one of its pillars was undercut. The current new bridge replaced this second bridge and at its feet, you can see a large weir that blocks the Gardon. The weir has a fish ladder to allow notable species of fish like eels, shads and lamprey eels, to migrate up and downstream.

Finally, the 1958 flood has left a few marks in the town, with a flood marker at the bottom of Rue de la Cournilhe which starts in front of the church.

From here, walk along the lane to the Gardon where you'll find another marker painted on a house that shows the astonishing height flood waters reached on 1 October 1958. This area of Remoulins is now protected from river bank erosion by sheet piles* and gabions*.

In 2002, the Gardon once again caused a lot of damage in this area of Remoulins and at the edge of town, towards Uzès, it even brought down a statue of the Virgin Mary (Place de la Madone).



La Madone after the 2002 flood.

Disaster in Aramon

Aramon lies 7 km across a wide alluvial plain from the Gardon and was, until the CNR* reconfigured the river, prone to frequent floods by the Rhône. One arm of the river even ran alongside the town.

To protect itself from the flood waters, Aramon built a flood barrier around the south and west sides of the town. It is built of stone near the town centre but becomes an earth bank further out. When the CNR* built their large dykes, they cut Aramon off from the Rhône and its flood waters stopped short of the town, while the authorities stopped maintaining the earth banks.

By the evening of 9 September 2002, the peak flood waters had reached the Lower Gardon and the confluence, squeezed into a narrowed riverbed mentioned earlier. The flood water could only partially reach the Rhône, so the rest breached the left bank just before Montfrin and flowed right up to the earth dyke. It was broken in 7 places and the water surged through, devastating recently built housing estates. Many of them were bungalows and dozens of homes were flooded in the middle of the night. Unfortunately, 5 people were killed and a large part of Aramon was flooded by the Gardon, perhaps for the first time in its history and definitely since the last few hundred years.

Just like Aramon, other surrounding villages were also flooded, such as Montfrin, Comps and Théziers.

In Comps an unusual event happened when the flood waters subsided. The Gardon had bypassed a large dyke protecting the village leaving the water trapped behind it on the village side. Once the Gardon regained its bed, the flood water was left sitting behind the dyke and caused the wall to collapse due to the weight of water.



Aramon town centre.



Flooded housing estate in the Les Charmettes district.

The new dyke at Aramon

Following this tragic event, the town of Aramon entirely rebuilt the western dyke, using the latest engineering techniques and design to withstand the level of risk.

It now has a spillway* and large sluice gates*.

The dyke was commissioned in 2003, just in time to contain a major flood of the Rhône on 3 December which managed to flow up the Gardon.



The new dyke at Aramon.

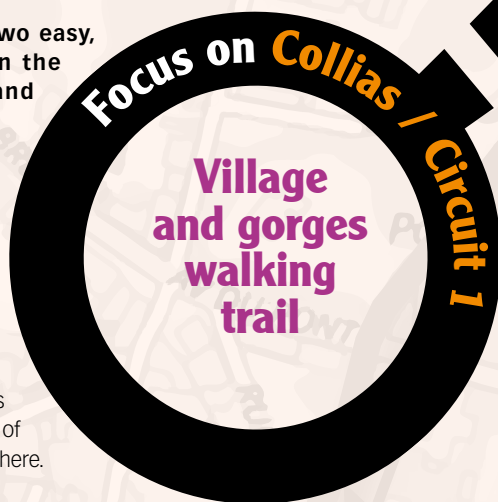
You can find a guidebook on the history of floods in Aramon at the town hall and at the tourist information office.



You can choose between two easy, all-ability, walking trails in the municipalities of Collias and Sanilhac-Sagriès.

The first, in Collias, features flood risks in this small, bustling village, especially in summer, when it is packed with visitors.

The second walking trail takes you on a trip up the gorges to La Baume, to the Chapelle de St Vérédème at Sanilhac-Sagriès. Here, you'll learn about the river's hydrology, geology and the wealth of outstanding flora and fauna found there.

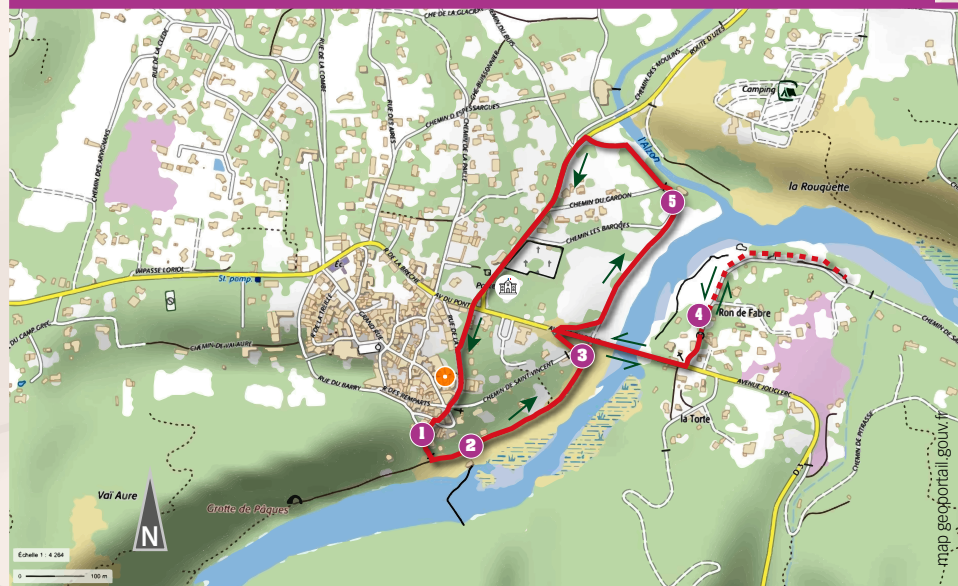


Circuit 1

The village walking trail: distance 1 km | 1 hour.

This short walk has five different points of interest. It begins at the town hall, then follows the Gardon to the St Vincent area and the Alzon River.

Please remember to look and listen when crossing roads in the town.





Village walking trail

Point 1: historic floods.

Rue du Barry. GPS. 43° 57' 07.33" N, 4° 28' 40.19" E
From the town hall, walk along the Route d'Uzès and cross Avenue du Pont. Continue straight on the Rue de la Mairie, then turn left on Rue de la République. After the junction with the Chemin de St Vincent, walk down the steps to your right, cross the Rue du Bas Quartier and continue straight ahead using the steps. Once you reach Rue du Barry, you'll see a municipal depot with 3 flood markers.

Serial flooding in 1907!

In 1907, the South of France was hit by repeated downpours of torrential rain and no less intense flooding. The Cévennes suffered particularly between 25 September and 16 October, with incessant rain, peaking 3 times.

In total, 1,395 mm of rain fell in the Cévennes, at Lasalle, on the banks of the Salindrenque while in Collias, rainfall was no more than 400 mm.

- On 25 September, the fiercest "Cévenol Episode" downpour prompted the first flood. Rain lashed the area for 6 days non-stop (710 mm of rain falling on Mont Aigoual) triggering numerous floods. At Collet de Dèze, on the Gardon d'Alès, a brand-new bridge was washed away, while at Alès, a house collapsed.
- On 8 to 9 October, after a relatively calm week, a new 'episode' dumped 250 mm of rain on 250 Lasalle (compared to less than 40 mm at Collias). The rain fell on already saturated land and the floods got bigger. At St-Jean-du-Gard, there was 1 metre of water in the streets. In Anduze, "furniture, carts, donkeys, pigs and huge trees were carried off in the flood waters, like toys. At the Lafoix paper factory the water reached the 1st floor and tonnes of paper were ruined.

- Finally, during the night of 15 to 16 October, more rain, albeit less intense, fell, triggering the biggest flood yet that reached Collias. Maurice Pardé* estimated the flow of the Gardon, at Remoulins, to be 3,200m³/s whereas the river module* at Sanilhac-Sagriès was just 32.7 m³/s. At Brignon, a bridge opened in 1904 was washed away and at Dions, the Gardon was more than 3 km wide just before it entered the gorges.

1958, a new series!

Two new major floods caused the biggest loss of life in the 20th century in France, since the Tarn disaster of 1930.

The fiercest of these floods happened on 29 September and was triggered by heavy downpours in the Cévennes (429 mm in 48 hours at St-Jean-du-Gard).

35 people died, including 21 motorists, 18 of whom died in the Gardonnenque (see page 14) between Boucoiran and St Chaptes, on 30 September.

There was huge damage at Alès, especially at the Pré St Jean, and 4 bridges were destroyed at Ners, St-Jean-du-Gard, Labaume and Cendras.

Forty-five towns and villages were hit by the floods and millions of hectares of crops lost. The cost of the damage amounted to 80 billion francs.

Rain fell again on 3 and 4 October (150 mm at Génolhac, in 2 days) causing another fierce flood, albeit less severe than

And 2002?

The depot where you saw the flood markers was not high enough and the flood water of 2002 reached some ten metres higher along the road, to a small post. Walk back along the road to find it.

The bridge at Collias, 1 October 1958.



Freak flooding in 2002

In late afternoon on Sunday 8 September 2002, torrential rain began falling on the Gard Department as well as parts of the neighbouring Vaucluse and Ardeche.

It was the start of a major “Mediterranean episode”. By evening, all the rivers in the area (Gardon, Cèze, Vidourle, Vistre, Ardèche, etc.) had reached stormflow and were already wreaking havoc on life and property between surface runoff and burst banks. On Monday 9, after a relative calm period in the early morning, it rained again after lunch. The ground was saturated so the rivers overflowed, this time even more powerfully.

Cumulative rainfall over the two days was off the dial: 684 mm near Anduze and around 400 mm at Collias, while levels were more moderate in the High Cévennes.

The toll was horrendous: 23 dead and more than 800 million euros of damage in the Gard.

More than 90% of towns and villages in the Gard were affected.

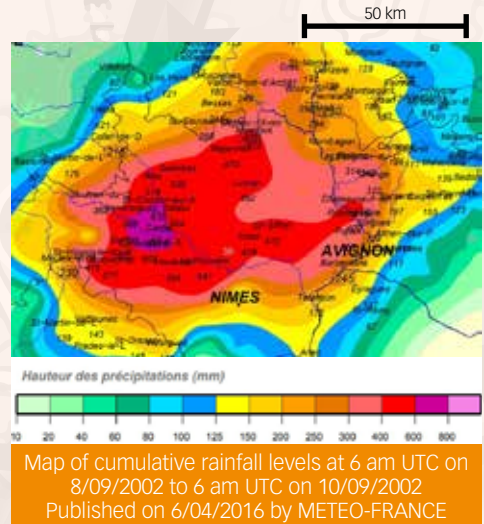


Although this flood was exceptionally fierce, it was due to the very high cumulative rainfall that had fallen on the entire catchment and Department. In the Cévennes, the upper catchments of the Anduze and Alès variants of the Gardon were relatively spared compared to the piedmont.

Ten, twenty, one hundred-year flood events, what does it mean?

In the Gardon de Ste Croix, at Moissac, the flood was only classified as a twenty-year flood event. It rose to a one hundred-year event at Anduze (as was the case at Alès for the Gardon d'Alès) before largely exceeding a one-hundred year event in the Gardonnenque.

These figures signify when a flood might reoccur but be careful, it's just a probability! For example, a ten-year flood doesn't happen every ten years. What it actually means is that each year after, there is a 1 in 10 chance of it happening again (1 in 20 for a twenty-year flood and 1 in 100 for a one hundred year flood event).



2



Watch the 2002 floodwaters pass beneath the Pont du Gard. The flow rate was estimated to be 6,500 m³/s at Collias.



And what about Collias?

These floods, and the events of 2002, have marked the history of the village.

There are some noteworthy stories about the 1907 floods, like the miller at the Fages watermill (see p 30) who escaped the rising waters on a small boat by a 1st floor window. Then there's the 1958 flood which swamped the iron bridge (see p 31). But, the flood of 8 and 9 September 2002 really caused huge distress and left lots of locals deeply traumatised. Thankfully, there were no fatalities in the village. It all began on 8 September when an 'organic' market was held on the banks of the Gardon.

Steady rain began to fall in late morning and grew heavier in early afternoon. Village council officials decided to close down all events and watched with growing anxiety as things got worse. Seeing that something serious was about to happen, they warned the most vulnerable residents to get to higher land. The bridge was shut and the Gardon kept rising, until on Monday 9 September at 4.56 pm precisely, it reached the deck of the Joliclerc Bridge. With no electricity or telephone lines, the village was cut off from the world.

When the flood waters subsided, the scene was one of utter devastation. Houses at Le Ron de Fabre and just before the gorges were completely destroyed. Roads were washed away by surface runoff, which also swept away part of the cemetery wall. There was no drinking water, either.

Emergency services, including the army and dozens of volunteers quickly arrived to help residents return to their homes and begin the clean-up. The community in Collias joined forces to overcome the damage but even now, many of those who experienced the devastation are still scarred by the experience.



Département du Gard

The Local Emergency Action Plan (PCS)

In 2004, a law amending the civil security system required municipalities to introduce emergency action plans for residents in the event of major crises (natural and technological hazards, outbreaks of disease, etc.).

Just as the village officials in Collias had done in 2002, if a flood warning is issued, the action plan prompts employees to muster all the human and technical resources needed to evacuate and shelter residents from at-risk areas, while closing exposed roads and lanes, as well as keeping local people and visitors informed of events.

In addition to these conventional measures, involving village council members, local police and council technical services, the village can also secure help from a group of trained community volunteers that form what is called the local civil security reserve.



Village walking trail

Point 2: Les Machines.

Quartier St Vincent. GPS 43°57'06.12" N, 4°28'43.60" E

Walk down the road to the banks of the Gardon, opposite the water mill.

This mill is called "Les Machines".

Water mills along the Gardons

There are lots of water mills along the rivers in the Gardons river catchment*. They are in varying states of decay and some date as far back as the Middle Ages. They demonstrate the vital nature of water power through the centuries until other forms of energy replaced it. The mills didn't just have one use but often, several. When needed, they could switch from one activity to another.

There were flour mills (moulins bladiers) that ground wheat or chestnuts, in the Cévennes, or fulling mills for clothmaking (moulins drapiers), bark mills (moulins à tan*) to work leather, oil mills and paper mills, especially at Anduze. In the Cévennes, some ground minerals to forge metals (trip hammer mills or moulins farguiers/martinets).

They all had dams or weirs to channel the water to the base of the mill along a mill-race. Once it had powered the mill's wheels, the water was released through a sluice downstream.

The water mill in front of you is called "**Les Machines**". Its name comes from an unusual dual-use that it took on in 1890 when it was already a ruin. In fact, it was used as a sump pump to supply the village with drinking water during the day and a turbine to generate electricity at night. Collias had 20 streetlights and 80 homes to power and became one of France's first settlements equipped with this technology. You'll find a plaque on the mill wall to commemorate this event.

Unfortunately, almost as soon as it began working, it was hit by two consecutive floods in September 1890, and October 1891 when its machinery was severely damaged. Further floods followed in 1907 and 1958 and finally, the 2002 flood sounded its death knell. A tree trunk sliced off its roof and knocked down part of the walls. Now open to the skies, its owner has long since left it to the elements.



There were other water mills in this part of Collias, like Le Moulinas, on the right bank.

In accordance with the law, the weir will soon be partially levelled to add a fish ladder for ecological continuity and enable certain species of fish to migrate up and down the river (see p 20).

Runoff water

The concrete strip crossing the lane is a manmade extension to a small gully. It channels and evacuates runoff water that flows down through the village. Remember, in 2002, runoff water caused huge damage.

Village walking trail

Stop 3: Joliclerc bridge

Walk downstream along the bank of the Gardon to the bridge footings, on the upstream side.

GPS : 43°57'11.48" N, 4°29'02.77' E

Keeping the community informed

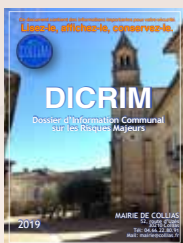
This bridge was opened in 1934 and is, like all bridges, very useful for measuring flood water levels and making comparisons. That's why the EPTB* Gardons has fitted two easy-to-see flood markers on one of the pillars.

The one, half-way up the bridge, commemorates the 1907 flood on 16 October. It relates to an old marker carved into the stone pillar on the downstream side (at the same height, of course!). Walk on a few metres to see it.

The marker set higher up, just underneath the bridge deck, commemorates the 2002 flood.

The EPTB* Gardons installed these markers in 2006 for the French "Risks" Act of parliament that was passed just after the floods in the Gard. The Act requires every French municipality subject to a Risk Prevention Plan (see p 29) to display the highest-known flood levels in the local area. Each marker has a standard design for throughout France in the form of a blue and white coloured badge featuring the date of the flood and the river. Working for its member municipalities, the EPTB*, has installed some 200 markers at more than 100 sites in 30 municipalities located in the Gardons river catchment. In Alès, the metropolitan authority has the responsibility for installing the markers.

The different municipalities must also inform the local community about any major hazards they are exposed to. The French government provides them with data which they then use to produce a Municipal Information Document on Major Risks (DICRIM). This is then sent to each household. The DICRIM for Collias was drafted in 2019 and is available from the town hall.



The Joliclerc bridge replaced an older suspension bridge.

Look at the bridge architecture. There are many gaps on the bridge deck to let water pass through easily and reduce the pressure on the structure. The bridge pillars have 'noses' which also avoid putting the bridge under too much strain and deflect large log-jams*.

Do you see the small holes half-way up the bridge, to the right of the 1907 flood-markers? They weren't caused by collisions with large objects carried by the flood waters but are actually bullet holes from an allied plane strike on 20 August 1944.



The Joliclerc bridge during the floods of 8 September 2002.

Take a look at this video taken from the top of the bridge by a walker, just a few days after the 2002 flood. You can see the destruction both up and downstream from the bridge, as well as damage to the "Les Machines" water mill, at the entrance to the gorges.



To get up onto the bridge, use the steps on the upstream side and stop at the small car park called, "Les Amarrages". On the downstream side you'll see a panel that tells

you about the history of the bridge.

Le Ron de Fabre after the flood in 2002.



Michael E. Doumailh



Jean-Pierre Meger

Village walking trail

Point 4: Le Ron de Fabre.

Cross the bridge then just after the twin buildings called Les Octrois, turn left in Chemin de St Privat. Stop at the car park on the left at the post with the flood-level markers.
GPS: 43°57'11.48" N, 4°29'02.77" E.

Thankfully, no one died in Collias, in 2002, but the damage was colossal. Part of the town called Le Ron de Fabre was hit particularly hard. Houses built on bedrock between the road and the Gardon, were literally swept away. When it flooded in 1958, there was just one building which just about clung on but in 2002, all that remained were the floor slabs and some building debris.



Georgette Grazziol

Le Ron de Fabre during the floods of 1 October 1958.





Extract from the statutory map in the PPRi for Collias. The PPRi can be consulted in Collias town hall and on the Gard Department Prefecture website (gard.gouv.fr).
Source: Gard Department Prefecture.

Urban development and flooding

In 1995, the “Barnier” Act introduced Risk Prevention Plans (PPRi) in France to control building in flood-risk areas. PPRi Plans were defined by the French State and added to existing Local Plans*. As such, it is now forbidden to build on undeveloped flood zones and those at high-risk of flooding. Building is

allowed in urban or moderate or residual risk areas but only subject to certain conditions. Collias got its own new PPRi in 2016, while others have been developed for groups of towns and villages in the Gardons catchment or for sub-catchments, such as the Gardon d’Alès PPRi.

.....

If you continue along the lane, you’ll arrive at a shingle beach. Look over to the other side of the river bank to see the difference in the colour of the rock just at the waterline and further above it. The rock is pale in colour due to constantly changing water levels, i.e. minor flood events. Higher up, the

rock is greyer and covered in microscopic lichen and moss.

If you like your stone ancient and dressed, why not walk back to the lane which leads to the wonderful Chapelle de l’Ermitage (hermitage chapel).



Village walking trail

Point 5: The Alzon.

Retrace your steps along the lane and cross the bridge. At the far end, take the steps on the right down to the river bank. Walk along the bank to a water mill 200 m downstream.

GPS : 43°57'19.73" N, 4°28'59.92" E

Optional detour: La Torte.

At the end of the bridge on the right bank, you'll find the start of a path called La Torte. It takes you to a fantastic panoramic view of Collias and the Uzège and an interpretation panel to help you read the landscape. This small detour takes 90 minutes, returning to the bridge.

Le Cavalier

Just before the water mill, you'll see a large rocky outcrop forming a small promontory above the Gardon. This is all that remains of the Cavalier. Which used to be much larger and several metres higher. Swimmers loved to use it as a place to jump from into the river, but the locals from Collias also used it as a reference point for the Gardon.

It was washed away in 2002 and lost forever.

The Hôtel du Gardon

On your left, in this pleasant green space with tables there once stood a hotel. It was called the Hôtel du Gardon and luckily it was empty in 2002 and even escaped relatively well from the flood damage. However, it was dismantled several years later and moved to another, safer, area of the town (Campchestève). A new housing estate was also built in Campchestève to relocate those who lost



The Hôtel du Gardon after the 2002 flood.

their homes to the floods, like residents in Le Ron de Fabre whose houses were, of course, never rebuilt.

Fages water mill

This mill is still in good condition because its traditional design has withstood the floods. It was, nevertheless, flooded right up to the top of the first floor window in 1958 and some 30 cm higher in 2002. Its height meant that the miller, who lived on the first floor, could always find shelter when a flood struck. Only tools and the machinery to work the mill were on the ground floor. Made of large, hard-wearing blocks of dressed stone, the mill is streamlined in the direction of the river flow. It also has a 'nose' to part the flood water, just like the Joliclerc bridge. This is what helped it withstand the 2002 flood, whereas just a few hundred metres away, houses in Le Ron de Fabre were swept away.

What remains of Le Cavalier.



The Hôtel du Gardon and Fages water mill on 1 October 1958.



The Alzon and Fages water mill after the 2002 flood.



The Moulin de l'Alzon water mill on 10 October 2014.

The iron bridge

Walk back up the Alzon River and you'll see what the people of Collias call the Iron Bridge, or "Pont de fer". Actually, there was an iron bridge here, built in 1890 which was replaced in 1969 by the one you see now, but the name stuck.

It was designed by the same engineers that built "Les Machines". The current bridge was engulfed by the 2002 flood, as the flood-level markers on the village side of the bridge indicate.

From up on the bridge, look straight down on the upstream side and you'll see the much older "pont remain" village bridge. On your right is a small water mill called "Le Moulinet" which the Alzon decapitated in 2002 while on the other bank is Collias' oldest water mill, called "Le Moulin de l'Alzon". It dates back to the Middle Ages although its archives were unfortunately lost in the 2002 floods.

Living and working in a flood zone

Although, in places like Collias, recent floods and town planning regulations have made some previously flood-prone areas of towns safer, France, as whole, still has a great deal of infrastructure at the mercy of major hazards.

Various measures, mandatory or voluntary, are now trying to reduce this vulnerability.

For instance, it is now compulsory to inform people about hazards when buying or renting houses. The

seller or owner must tell the buyer or tenant about any major risks which they might be exposed to. This process is called the **IAL** (Buyer-Tenant Information). At school, the head teacher must draft a plan, like the **PCS local emergency plan**, to ensure pupils and staff are safe. This is called a **PPMS** (special school safety plan).

Campsites are especially vulnerable and there are great many on riverbanks in the Gard. As a result, they must also have emergency plans.

Finally, the general public can secure guidance on a voluntary basis to carry out vulnerability assessments and family safety plans (**PFMS**).

Private companies and premises open to the public also have their equivalent in the **POMSE** (Workplace organisation and safety plans).

Most of the time, these measures are implemented by local authorities and river boards.



Get a bird's eye view of the Alzon and the Gardon in this flood drone footage shot by the Product Air © Company product-air.fr

To return to the town hall, walk back along the Route of Uzès to the town.

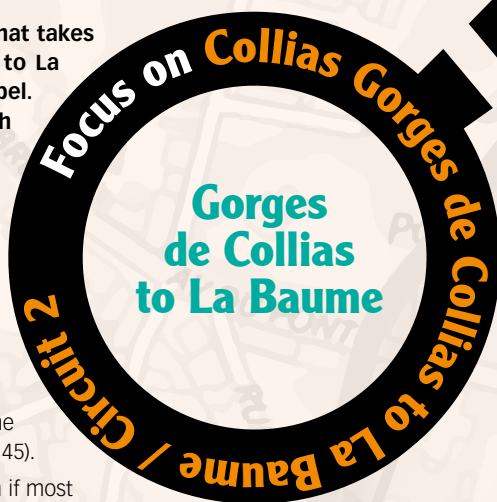


This is an easy walking trail that takes you along the Gardon River to La Baume and St Vérédème Chapel.

The trail has six sections. Each one focuses on a different topic reflecting the changing scenery on the walk.

Before you start, we strongly recommend you check the weather forecast, especially the weather alert map issued by Météo France and the vigicrues.gouv.fr website for official data on the river levels and how fast the Gardon is flowing upstream (see p 45).

Lastly, do wear hiking shoes. Even if most of the trail is easy, there are some sections over rocks that might be slippery.



Circuit 2

Gorges de Collias to La Baume walking trail, Distance and time: **9 km** | **4 hours**.

> This short walk has five different points of interest. It begins at the town hall, then follows the Gardon to the St Vincent area and the Alzon River.

Please remember to look and listen when crossing roads in the town.





Collias to La Baume walking trail



Section 1: Exiting the gorges

Walk into the gorges following the Gardon upstream on the left bank.

The starting point is also point 2 on the village walking trail "Les Machines"

GPS 43°57'06.12" N, 4°28'43.60" E



A highly protected site

When you enter the gorges, a sign tells you that you are in a French State-listed site (site classé).

In fact, the Gardon Gorges have been listed since 1982, while the protected area was extended in 2013 when an additional 7,800 ha of plateaus and peripheral farmland on the outskirts of Nîmes were included.

This protected status safeguards the area's landscape qualities.

The Gardon Gorges also include two Natura 2000* sites (ZPS* and ZSC*) to conserve and protect certain rare European species.

Other areas also have protected status such as the village of Sanilhac-Sagriès where a regional nature reserve protects flora, fauna, land, water, mineral deposits and fossils.

Finally, one area is specifically devoted to protecting the Bonelli's Eagle, with a Prefectoral Biotope Protection Order

(APPB).

We'll come back to this in section 6, on page 42.

The canyon effect

If you walk on a further 100 metres or so, you'll see on your right an earth mound supported by a low wall. Two houses once stood here that were almost totally destroyed by the height and force of the Gardon floodwaters.

A river's flow behaviour depends on three separate parameters: height, width and velocity (speed).

If you reduce one of these three parameters, the other two rise. When the floodwaters exit the tight gorges on the Gardon, they are very high and flowing fast. You can get the same effect if you cover the end of a hose with your thumb to make the jet of water more powerful. The houses were subsequently demolished and the residents relocated. You can see the houses at the end of the video on page 27.

The Grotte de Pâques

Walk on another hundred metres and you'll come to a fenced-off cavern*. This is the entrance to the Grotte de Pâques cave and the fence is there to prevent access to a drinking water borehole that you can see at the cave entrance. The borehole takes water from the karstic* underground network to supply the town (see p 39).

There were 48 wells in the village of Collias, including three municipal ones. They extracted water from depths between 1.5 to 22 metres. Those still working today in private homes and used to water gardens.

Water supply is currently under pressure. More water is being used to irrigate farmland while the numbers of private boreholes are rising, both of which are exacerbated by the impact of climate change. Baseflow levels* in rivers were already critical but may well get worse. A new drinking water borehole is currently being completed on the site where the two houses mentioned above once stood.



Collias to La Baume walking trail

Section 2: The riparian buffer

Continue walking up the Gardon. Next, you'll see a sign displaying rock climbing routes and a via ferrata cable trail. Walk on a little further to meet the riparian buffer.

GPS coordinates for start of section: 43°56'59.82" N, 4°28'23.78" E



White poplar bark.

The **riparian buffer** is a corridor of plant life bordering rivers that benefits from nearby water sources. As a result, the tree species forming the riparian woodlands need plenty of water. King of trees in this environment is the white poplar, which you can recognise by its trunk. It's called an "Aube" in the South of France and often grows next to its cousin, the black poplar (or "Piboule"), which you can spot

by its "ace of spades"-shaped leaves. One other common species here is giant Provencal reeds which are used to make reed matting as a sun screen. It is the tallest grass species in Europe.

See just how different the vegetation here is compared to plants that grow on rocks reaching up to the cliffs just a few metres away. The plants here are adapted to extreme drought conditions and are a sign of the garrigue that envelopes the plateaus high above the gorges.

The riparian buffer is hugely important for ecology as it provides shelter for various fauna, especially lots of insects which are vital for healthy rivers.

A river without a riparian buffer is systematically far ecologically poorer. That's why it deserves recognition, especially in a protected area like the gorges.

Riparian forest and hydronymy*

Some rivers are named after types of trees. There's the Aulne (Alder), including the common alder (*alnus glutinosa*) which practically grows standing in water.

The Alzon River also takes its name from the alder, together with its many variants (Auzon, Auzonnet, Alzonnet, Alzonne, etc). These are names commonly found throughout France.



Common alder leaf.

Managing log jams

The downside of riparian buffers is that they generate lots of debris dams that collect in the flood waters. You'll have probably seen some piles of logs and branches at the entrance to the gorges which were deposited there by recent, minor floods.

These debris dams can sometimes be dangerous for infrastructure immediately downstream when river levels rise.

As such, the EPTB* Gardons clears the most at-risk areas each year, especially large tree trunks that could jam at bridges or crash into houses.

This riverbed maintenance is carried out less often on areas further away from property and facilities.



Debris dams piled up against a house in Corbès, near Anduze, in 2002.



Collias to La Baume walking trail

Section 3: The gravels pits

Continue along the path, leaving the woods behind you and arriving at a shingle beach on the river bank. Make a brief detour from the path.

GPS coordinates for start of section: 43°56'49.21" N, 4°28'16.84" E

The "Gardon transport and demolition company"

The beach is made from millions of small pebbles in different shapes and sizes. They come from hills upstream where erosion has gradually eaten away at the land. The shingle looks as if it's always been there but flood waters actually brought it here, flowing high and fast enough to carry the stones, break them and round off sharp edges. Some of the shingle you see before you will be plucked up by the next flood, but for the time being, they sit here peacefully on this beach.

The fact that the shingle has been deposited here

is no accident. The Gardon enters into a slight meander (bend) here. On the inside of the bend, the water flows more slowly and the pebbles build up (number 1 on the diagram). On the opposite bank, the speed increases and the water can erode (number 2). Although rocks are fairly resistant to erosion by the water, the softer banks can be washed away. This is called scouring*. When the river is in flood, the water forges straight ahead and cuts the meander (red arrow). Any built-up areas inside the meander are highly vulnerable.



Fond de carte geoportail.gouv.fr

The sheer range of pebbles reflects the geological diversity in the river catchment. Most of the High Cévennes is made of crystalline* rocks like granite and schist. Further down, on the lower Gardon de St Jean River, towards Peyrolles, the rock is mainly limestone. There are no crystalline rocks further downstream, while the largest area of limestone that the river flows through is the gorges.

Here are 3 pebbles. Can you tell which two come from the High Cévennes?



1



2



3





EPTB Gardons

Atuech Lake (plan d'eau), near Anduze is an old quarry that has been converted into a recreation space.

Aggregates

There are countless shingle banks (gravel pits) all along the Gardon's course.

Many of them have been worked, especially in the 20th century, to produce building materials. When they are quarried, these river deposits of pebbles, sand and other sediments* are called aggregates. To collect the aggregates, they are dragged from the streambed* to the banks.

The French Water Act now forbids any quarrying activities in the streambed*. As a result, many quarries have shut down. Only aggregates outside streambeds and intermediate channels* are allowed to be quarried. These workable deposits are actually sediments* from the Gardon's ancient, abandoned riverbeds.

When the quarries closed, they left a great many water bodies, such as lakes, in the Gardon river corridor. You can easily spot them if you look at a map.

Today, the river is naturally reshaping its river bed, just like at Tavernes, on the Gardon d'Alès, just upstream of the confluence.

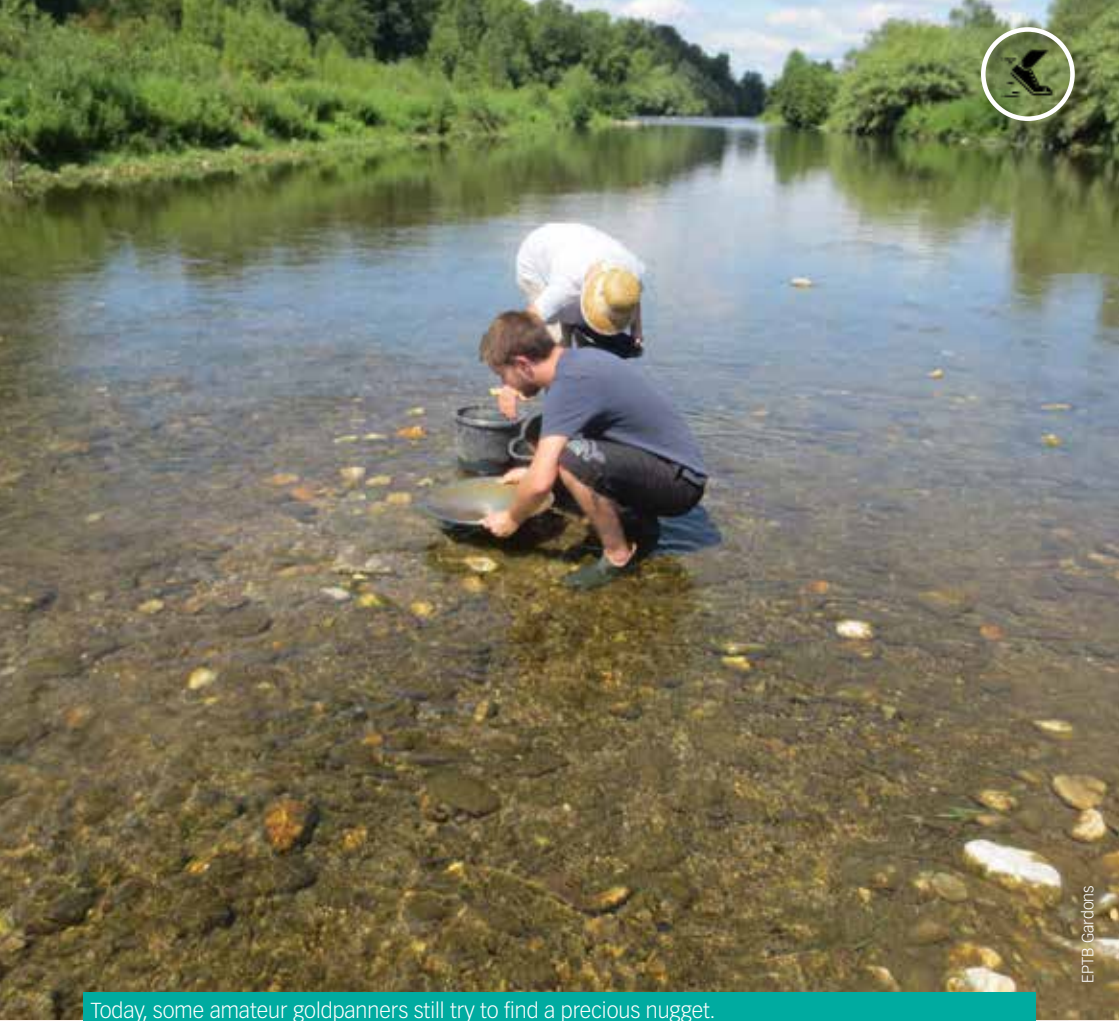
The Blocks

Look at these huge angular blocks on the right-hand riverbank. One of them is perilously balanced above the Gardon. They come from the slopes further up and came to rest here due to a key process that shapes the Mediterranean landscape: freeze-thaw cycles.

Limestone rocks actually have hundreds of tiny cracks that fill with water. When the frosts come, the water freezes and expands in the tiny cracks. When the ice melts, the pressure drops but when the cycle repeats itself, stone blocks of all sizes become loose and fall by gravity to the lower slopes. Surprising as it may seem, freeze-thaw is very common in our Mediterranean climate and from one year to the next, you'll find fresh falls of new stone, especially in spring.

One day, these blocks of stone will be carried away by the Gardon, as happened to Le Cavalier (see p 30). They will be broken down into many pieces to eventually form new pebbles and then finer and finer grains of sand.





EPTB Gardons

Today, some amateur goldpanners still try to find a precious nugget.

The goldrush

The Gardon doesn't only transport limestone or granite pebbles. There's gold too! It is released from the crystalline rock in the Cévennes and carried away by the river, albeit in tiny quantities.

But this wasn't what people believed in the late 19th century, when drilling prior to building Russan bridge revealed a deposit of 3.5 kg of gold per tonne of sand.

Gold fever struck and even the French gold mining company built a railway in the gorges to prospect for the precious metal.

Unfortunately, the find at Russan was a one-off and no other vein of gold worth mining was found. After three years of unsuccessful prospecting, between 1898 and 1901, the whole thing was abandoned.

« No one has ever made a fortune from gold in the Gardon »

Jacques Bourjas, ex-Mayor of Cardet.



Collias to La Baume walking trail

Section 4: The 2017 fire

Walk back upstream through the gravel pit and just at the edge, you'll see a small trail to re-join the track you started out on. Walk about 200 metres into the riparian woods and suddenly blackened, burnt tree trunks appear. A little further on, a track drops steeply to the riverbank. Don't take this but instead continue on to find yourself in the midst of a burnt forest.

GPS coordinates for the burnt forest 43°56'41.16"N, 4°28'01.58" E

From one hazard to another



On Sunday 27 August 2017, at 6.30 pm, a fire started on the banks of the Gardon close to the track you are walking on. Quickly, it leapt up the slope and enveloped some very dry vegetation, with lots of highly inflammable Aleppo Pine trees.

The fire probably started from a discarded cigarette end or a barbecue that got out of control.

Whatever the cause, it was negligence and even broke rules protecting the site.

The fire needed a large number of people and technical measures to combat it 140 firefighters from the Department in 30 vehicles were backed up by extensive air support

The power of plants

Look at these tall bushes growing at the foot of the burnt trees. Most of them are 2 m-high thickets of strawberry trees, less than 2 years old. Vegetation can quickly regenerate after a fire, however repeated



The Dash, is the largest firefighting plane that the French public safety services own. It can drop 10,000 litres of water and knock out fires, while ground-based teams can move in an extinguish the fire. Firefighting planes are stationed at Garons, close to Nîmes.

(7 Canadairs, 4 Trackers et 2 Dash aircraft).

Nine walkers trapped on the banks of the Gardon were lifted to safety by helicopter. Once it reached the slope, the fire spread to the tinder-dry garrigue vegetation on the plateau and was stopped at the edge of the first houses in the village.

Despite the steep slopes, the fire was finally brought under control at 10.30 pm after burning through 30 ha.

Hazards and land-use

Rising urban growth over the last fifty years in our region has only worsened flood risks but the risk of forest fires is increasingly noticeable too. Towns and villages are spread out, but as lots of farmland is abandoned, the forest gains ground. The Aleppo Pine is one of the main trees that has flourished in this change.

On the edge of town, where buildings and forest meet, the risk of fire is very high. As a result, local residents must follow certain basic safety rules outlined in the DICRIM*. In this case, visitors have unfortunately not obeyed the rules that were nevertheless clearly displayed at the entrance to the gorges.

outbreaks of fire in the same area definitively deplete plant cover, which then increases the risk of surface runoff and flooding.



Collias to La Baume walking trail

Section 5: The karst temple

Continue a further 400 metres along the track. The riparian woods thin out and the scenery is increasingly stony. A bit further on and it's just bare rock.

GPS coordinates for start of section: 43°56'36.50" N 4°27'36.54" E

Plunging into plankton

As we've seen, the gorges have been carved out of a limestone massif.

This is all that remains of an ancient sea that covered the region some 125 million years ago. The waters were shallow and warm, similar to the scenery you'll find in the Bahamas, today. The sea abounded with animals, such as the famous ammonites. Most of all, the sea contained huge quantities of Plankton. Animal plankton (zooplankton) had a calcareous shell and when it died, it settled on the seabed which was scattered with coral. Building up over millions of years, the remains of this plankton formed a layer of limestone some several hundred metres thick.

This layer was then squeezed when Africa and Europe began to move towards each other. It then rose up and folded, emerged from the sea and broke into pieces. Large faults several hundred kilometres long and 200-300 metres deep developed while, on a far smaller scale, tiny cracks (joints) and even invisible microscopic fractures also formed.

The hills in front of you now are in fact just the top-most part of the limestone layer which extends hundreds of metres, deep below the surface.

This is the mass of limestone that the Gardon carved through to form its gorges.

The birth of karst*

Although limestone is a very compact rock, its tiny cracks make it highly permeable. Water falling on the surface penetrates very quickly. But, as the water is naturally acidic it slowly dissolves the limestone, starting at the cracks and fault lines. These cracks gradually widen and underground cavities form in all shapes and sizes. Over time, some eventually join others and end up creating huge caverns hundreds of metres deep.

After several million years, the massif becomes a Swiss cheese, full of holes, creating a Karstic* network.

Limestone pavements

Dissolving limestone and the resulting formation of karst doesn't just happen at depth but on the surface too, where the limestone is eaten away.



At La Baume, a large rock that has fallen away from the hills gives you an idea of the Karstic network.

This process sculpts the stone into various intricate forms like a silversmith might make. They are called limestone pavements.

You'll see some surprising shapes and forms on this section of the walk, such as hollows made by stagnant pools of water. When the river rises, these sometimes trap pebbles which spin around in the cavity like a washing machine and eventually create perfectly circular potholes.

Water, from surface runoff, often leaves what look like 'scratch marks' similar to those a bear might make.

The invisible water trail

On the surface, karst* can rapidly absorb very large amounts of surface runoff.

As a result, the soil is extremely dry and only the right type of vegetation can grow there. This is called garrigue.

Deep down, however, the water flows through a vast, deep and highly complex network (mostly under the Gardon riverbed). Here, the water flows much more slowly as it filters down (losses) and sometimes re-emerges at springs (resurgences) many kilometres downstream.





Hollows, potholes and scratch marks.

Specialists use non-harmful coloured dyes to understand these underground networks with some surprising results!

In 1967, a dye tracer released at Dions submersible bridge re-emerged at the Grotte de Pâques cave **in Collias, some 15 km away!**

The cool waters of the Gardon are due to the addition of karstic* waters to the river. After a long journey through the limestone, hidden from the intense heat, the chilled water re-emerges in various locations at around 13 degrees Celsius.

Tracer testing by the EPTB*Gardons at Dions.



The grip of the Gardons

When the surface water in the river is at its summer baseflow* level, the karst* swallows it up.

In summer, the Gardon riverbed between Ners and La Baume is completely dry but water is still there. You can't see it but it's flowing below the surface in the underground network. When the first heavy autumn rain falls, water levels rise and replenish the Gardon riverbed. This process is rarely seen as once the water returns to the Gardon River, you have to wait until next summer to see the dry riverbed again.



When the rain is heavier, severe runoff creates torrents that rush down the hillsides replenishing springs that burst out of the cliffs. The "fossilised" karstic networks also become active again while the rain falls.



The European beaver.

The beaver in the wadi

An animal that thrives in the karst is a rodent commonly found in the gorges, called the European beaver (Castor Fiber).

It digs burrows into the earthy banks of the Gardon, with the entrance underwater to ward off predators like foxes. However, when the river drops to its baseflow* in summer, the entrance is revealed.

When this happens, the beaver quickly relocates its young to harder-to-reach cavities in the karst.

This behaviour for beaver species is apparently quite unique compared to elsewhere in the world.



Collias to La Baume walking trail



Section 6: La Baume de St-Vérédème

Continue along the path and after about 100 metres, you'll arrive at a junction. Walk in the direction of the St Nicolas bridge and La Baume. 150 metres further on, just after some large boulders, follow the track downhill and continue on it. There you'll see some new sections of limestone pavement that look like small dunes.

800 metres further on, after passing a new gravel pit and a shingle bank, you'll arrive at "La Pierre Tombée". This is a large rock fitted with a cable to hold on to so that you can get past it easily. Just after, you enter into a rocky landscape where you'll find an amazing collection of hollows. You'll also find some karstic* springs where water seeps out according to season.

The springs are coated in tufa, which is a blend of limestone and plant matter.

Continue on and after about 600 metres, re-join the upper path after the last gravel pit.

GPS coordinates for start of section 43°56'29.91" N 4°26'43.56" E

The thalweg: Here, in this forest of holm oak, you'll cross a thalweg* with gullies that demonstrate the power of surface runoff that rushes down from the hills during storms.

Bonelli's Eagle

This is the boundary of a protected area for the Bonelli's Eagle (APPB*).

The wingspan of this magnificent bird of prey can reach 170 cm and this particular site has 3 couples nesting in the rocks, high above the gorges. There are just 38 couples in the whole of Southern France and they mainly feed on other birds that they hunt in the garrigue above the gorges.



Bonelli's Eagle.

There are other migratory birds of prey on the gorges too, such as a couple of Egyptian vultures and short-toed snake eagles that mainly eat reptiles. You might also see a Montague's Harrier or some Black Kites, which are common sights along rivers as they feed on dead or sick fish. You can easily spot them by their v-shaped tails.





The water mills of La Baume

Continue on the trail to another junction with a sign. Take the track running alongside the Gardon towards the St Nicolas bridge and you'll arrive at the rocky riverbanks of La Baume. Here, two wonderful water mills stand facing each other. The largest, on the right bank is built in a similar style to the Moulin de Fages (p 30). The steep track that rises above it goes to Poulx, which was used in the Yves Montand film, "Le Salaire de la Peur".

The second water mill, on the left bank, is a lot smaller but robust enough to survive two floods several metres deep. It also still has its millstones.

The legend of St Vérédème

Climb the steps to reach the cave and chapel of St Vérédème with its 13th century paintings.

St Vérédème was a Greek-born hermit, who lived

from 640 to 720. He came here with St Gilles to find solitude before becoming Bishop of Avignon. Legend has it that he had many powers, especially one that brought on much-needed rain. Indeed, although the Gardon sometimes generates impressive floods, the river's baseflow* and general lack of water in summer are very challenging so, long ago, the residents of Sanilhac used to make an annual pilgrimage here to seek relief.

Remember! The cave is closed from 15 November to 15 March to leave the resident bat population in peace during their hibernation and from 1 May to 15 August when they mate.



Staying informed and safe if a flood happens

Warnings and alerts

Don't confuse weather warnings from Météo France that provide information to the general public on likely weather events and alerts issued by the authorities about imminent risks. Alerts, for example, involve taking safety measures as part of Local Emergency Action Plan (PCS) described on page 25.



**JE M'ÉLOIGNE
DES COURS D'EAU**
et je ne stationne pas sur
les berges ou sur les ponts



JE M'INFORME
et je reste à l'écoute
des consignes des autorités
dans les médias et sur les
réseaux sociaux en suivant
les comptes officiels



**JE ME SOUCIE DES
PERSONNES PROCHES,**
de mes voisins et des
personnes vulnérables



**JE NE DESCENDS PAS
DANS LES SOUS-SOLS
ET JE ME RÉFUGIE
EN HAUTEUR, EN ÉTAGE**



**JE NE M'ENGAGE NI
EN VOITURE NI À PIED**
Pont submersible, gué, passage
souterrain... Moins de 30 cm d'eau
suffisent pour emporter une voiture



**JE NE PRENS PAS
MA VOITURE
ET JE REPORTE
MES DÉPLACEMENTS**

Always follow these instructions in the event of a flood!



JE NE SORS PAS
Je m'abrite dans un bâtiment
et surtout pas sous un arbre
pour éviter un risque de foudre



**JE NE VAIS PAS
CHERCHER MES
ENFANTS À L'ÉCOLE.**
ils sont en sécurité



SPC Grand Delta flood monitoring station at Alès, under the Pont Vieux

In the past, the post office at Ners used to call the next one at Collias to report a flood.

Georgette Grazioli

Weather warning map of 11 October 2014.



Source: Météo France

Stay informed!

Flood warnings are based on data and weather forecasts provided by Météo France and hydrological data issued by SCHAPI*. This is a department of the French Ministry for Ecological and Inclusive Transition (the ministry tasked with major hazard prevention) that gathers data from 19 flood forecasting centres (SPC) throughout France.

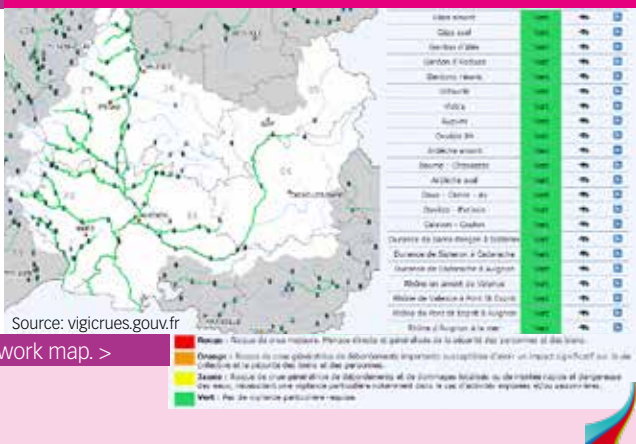
These units now enable 75% of French residents to be kept informed about river levels.

Two information tools that everyone can access are the Météo France weather warning map, which often appears on the television news, and SCHAPI's* vigicrues.gouv.fr website.

On vigicrues.gouv.fr, you can see contour lines (heights) and/or the flow rates in rivers likely to pose a threat to towns and villages.

For Collias, the SPC Grand Delta monitoring station covers the lower Rhône river catchment and its tributaries.

The municipality takes its references from the data point at Ners. This means it knows when flood waters will arrive and how high they will reach. It takes 5 to 6 hours for reported flow rate at Ners to reach Collias. The data point at Russan is too close to warn the village's residents in good time.



Source: vigicrues.gouv.fr

SPC* Grand Delta network map. >

Glossary

APPB: Prefectoral order for the protection of the biotope.

Baseflow: Low-water level.

Camisards: (Huguenots) Protestants in the Cévennes that fought back against persecution following the revocation of the Edict of Nantes in 1685, by Louis XIV.

Cavern: A natural rock shelter.

CNR: Compagnie Nationale du Rhône (Rhône River Management Authority).

Cofferdam: A barrier, often a wooden plank or metal sheet placed across doorways to stop water from entering. The same name also applies to larger-scale flood defences that block off gateways in walls surrounding some towns and villages.

Competence : Mechanical erosion and transport capacity of a river.

Crystalline: Silica-rich.

DDTM: Departmental Directorate for Land and Sea.

Debris dam: An object transported by a river that could obstruct the flow of water at a narrow point, such as a bridge. The name also applies to the natural dam that subsequently forms.

Debris line: The visible line indicating where flood waters reached their highest point.

DICRIM: Municipal Information Document on Major Risks.

DREAL: Regional Directorate for the Environment, Development and Housing.

EPTB: Etablissement Public Territorial de Bassin (Public river catchment authority).

Flood extent: Surface covered by a river in flood.

Floodplain: The widest area occupied by the river when it overflows its banks. It is defined by the largest recorded flood event.

Flow rate: the amount of water passing the same point over a given period of time, measured in cubic metres per second (m³/s) or in litres per second (L/s).

Gabion: A robust steel cage commonly filled with stones and used in public works to protect riverbanks from scouring.

Henri Pitot (1695-1771): Engineer and Director of Public Works for the Province of Languedoc.

Hydronymy: The science behind the names of water courses.

Intermediate channel: The part of the floodplain regularly flooded by frequent stormflows.

Karst: Chemically eroded limestone.

Little Ice-Age: A cold period that occurred in Europe and North America from roughly the early 14th to late 19th centuries.

Local Plan: Local land-use designation plan

Maurice Pardé (1893-1973): Eminent academic, innovative researcher and founder of Potamology*. Pardé conducted ground-breaking work to rank and define the features of flood events worldwide.

Module: Combined annual mean flows over a number of consecutive years (at least 30).

Natura 2000: A European Union network of natural or semi-natural sites containing outstanding fauna and flora with a notable heritage value.

Nostradamus: Michel de Nostredame (1503-1566), Provençal physician and astrologist who lived in the Renaissance period. He is famous for his quatrains that some consider to be prophecies.

Piedmont: large area at the foot of a mountain or mountain range.

Potamology: The study of water courses.

Retain: Reduce the maximum flow rate of river during a flood event.

River catchment: The area in which drops of water all flow towards the same outlet (river, lake, sea or ocean).

River in good condition: Certification awarded by the French Water Agency for a river based on water quality.



Run: A track regularly used by animals SCHAPI: French Central Hydrometeorology and Flood Forecasting Support Service.

Scouring: bank erosion by the mechanical energy generated by river flow.

Sediment: Particles deposited by a water course.

Sericulture: Breeding silk worms.

Sheet piles: Steel sheets used to protect riverbanks from scouring*.

Sluice: Hydraulic valve.

SMAGE des Gardons: Joint Association for the Development and Balanced Management of the Gardons.

SPC: Flood Forecasting Service.

Spillway: A structure built to release water from a sluice or permanent dam when water levels exceed a set limit (e.g. the height of a dam).

Streambed: The channel occupied by a river at its annual mean flow.

Tanbark: dried oak or chestnut tree bark used to tan animal hides.

Thalweg: A line formed between the two lowest points, either a valley or a streambed.

Torrential: floodwater or surface runoff conditions where the flow and speed and volume of water rises rapidly.

Valat: A southern French word for a thalweg or stream.

Wild river: Certification awarded by a grouping of French and European institutional and scientific representatives to a water course for the quality of its ecological functions.

ZPS: "Gorges du Gardon" Special Protection Area designated by the "Birds" Directive

ZSC: "Le Gardon et ses Gorges" Special Conservation Area designated by the "Habitats" Directive



La Maison du castor

visitor centre

Open from March to October,
from 10am to 6pm.

The Maison du Castor (Beaver Centre) lies on the banks of the Gardon at Collias. It is a special visitor centre focusing on the Gardon and beavers. There is a museum, an area to rest and relax and an outdoor theatre area. The museum combines fun and learning, enabling visitors to discover the river in all its splendour, how it works, its biodiversity and heritage. The spotlight then falls of the beaver where you can find out more about the ingenious tricks it uses to adapt to its surroundings. Young children can, for example, follow a beaver run*. There are also guided visits of the centre and to nearby nature reserves with the Gardon gorges as a scenic backdrop. The Maison du Castor really is a must for local people or visitors looking to enjoy a pleasant, calm and peaceful haven on the banks of the Gardon, in stunning surroundings.



**The author would like to thank the following people
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Recommended reading:

- Pauline Van Hoogenhuizen "Collias dévoilé, un village du Gard", published by La Fenestrelle.
· Guilhem Fabre and Jean Pey, "Le Gardon et ses gorges", published by Les Presses du Languedoc.

Useful websites:

georisques.gouv.fr:

Ministry for Ecological and Inclusive Transition website devoted to major hazards
paca.developpement-durable.gouv.fr and occitanie.developpement-durable.gouv.fr:

Websites managed by the Ministry for Ecological and Inclusive Transition in PACA and Occitanie.

gard.gouv.fr: website for the Prefecture of the Gard.

vigicrue.fr: Vigicrue website.

météofrance.fr: French weather agency (weather warning map).

collias.fr: Website for the village of Collias.

gorgesdugardon.fr: Gorges du Gardon Joint Association website.

les-gardons.fr: EPTB* des Gardons website.

noe.gard.fr: Gard Departmental Council website on flooding.



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The Gardon at stormflow at the Pont du Gard in 2002, Jean-Pierre Méger - 2002 flood-level marker, EPTB Gardons - Collias, Benoit Garrec.

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Gardon and Gardonnades!

The Gardon, or rather Gardons, have always triggered brief albeit very intense, even monumental, floods. These encompass the Cévennes mountains that give their name to the famous “Cévenol Episodes” of extremely heavy downpours that stretch all the way to the plains bordering the Rhône River.

The local name for these floods is “Gardonnades”.

This geo-guide firstly tells you about the Gardon river catchment, a bit of history and some of the river’s most notable floods that have sometimes left a trail of devastation in towns like Alès, Anduze or Remoulins. The floods of 1907, 1958 and especially 2002, were unprecedented and left their mark on the landscape and in the minds of local people.

Many villages have also felt the might of the Gardon and its floods.

Collias is one example, just at the exit of the gorges, where two specially designed walking trails, accessible to all, give you a rare insight into the river and its fearsome floods.

The first walking trail takes you on an introductory tour of the village, while the second leads you to the gorges which are listed for their outstanding natural heritage and breath-taking scenery.

