

PETITE NATURE?



36 questions pour décoder le lac



ENGLISH TEXTS



Quai Louis Bonnard 8
1260 Nyon
T +41(0)22 316 42 50
www.musee.duleman.ch

Heures d'ouverture :
Mardi-dimanche et jours fériés
Avril - octobre : 10h - 17h
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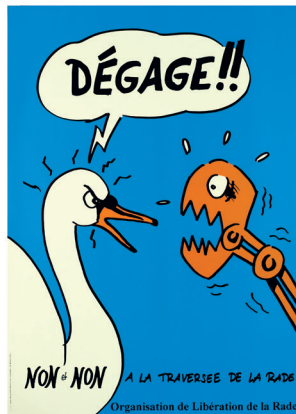
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DU **léman**
& AQUARIUM



36 questions is a lot !

To discover the exhibit, spin the wheel. A question will appear : to find the answer, walk towards the display positioned under the matching symbol.

You can find the symbols at the bottom right of the translated texts.



LE CYGNE EST-IL UN OISEAU DU LÉMAN ?

Originaire de la mer Baltique, de la mer Noire et du sud de la Sibérie, le cygne tuberculé (*Cygnus olor*) serait arrivé sur le Léman au début du 19^e siècle. L'estampe présentée ici, qui date de 1802, constitue le plus ancien témoignage de cette arrivée. On y voit sept cygnes remontant le Rhône à Genève. Mais il s'agit peut-être d'une simple vision de l'artiste.

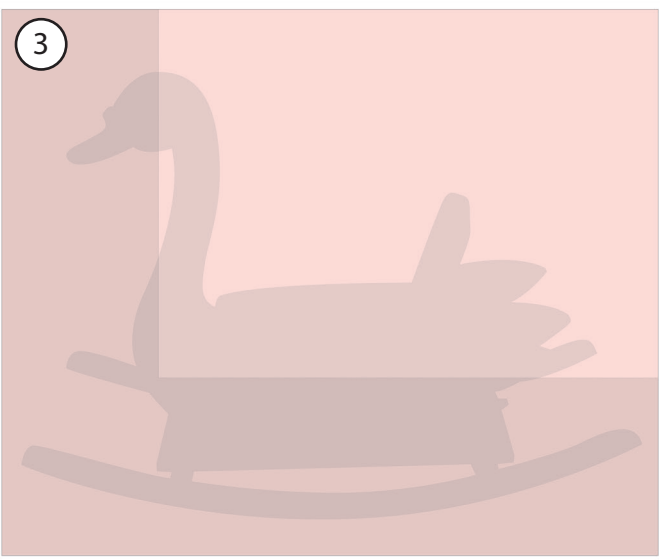
La présence de cygnes sur le Léman est avérée depuis 1837. Cette année-là, la ville de Genève en achète un couple. Deux ans plus tard, elle en reçoit deux autres de la part du prince de Fürstenberg. Ces individus se sont sans doute reproduits, car en 1837 la ville de Genève offre deux couples de cygnes à la ville d'Annecy. L'année suivante, elle fait cadeau d'un autre couple de ces volatiles à la ville de Vevey.

L'espèce s'est multipliée depuis – en 2016 le Léman comptait 541 cygnes – sans pour autant déstabiliser l'écosystème. Devenu l'un des emblèmes du lac, il est le premier oiseau du Léman à être protégé par la loi suisse dès 1970. Du côté français, sa chasse ne sera interdite qu'en 1962.

1



2



3

Is the swan a Lake Geneva bird?

The mute swan (*Cygnus olor*), native to the Baltic, the Black Sea and Southern Siberia, probably arrived on Lake Geneva in the early 19th century. The print shown here, dating from 1802, is the oldest piece of evidence in this regard. It depicts seven swans on their way up the Rhone to Geneva, but it is perhaps only an artist's impression. The presence of swans on Lake Geneva is documented from 1837 on. The city of Geneva bought a couple of swans that year and two years later received another two from the Prince of Fürstenberg. They must have bred since in 1857 the city of Geneva gave two pairs of swans to the town of Annecy. The following year, it gifted another pair to the town of Vevey. Since then, the numbers of swans have increased – in 2016 there were 561 on Lake Geneva – without, however, affecting the stability of the ecosystem. The swan has become an emblem of Lake Geneva and was the first of its birds to be given protection under Swiss law in 1875. On the French side of the Lake, it was only in 1962 that swan hunting was banned.

1.

“No, and again no to the Geneva harbour crossing”, 1996, Sandra, reprint of a poster. At the time of the popular vote in 1996, the people of Geneva rejected the construction of a bridge or a tunnel across the harbour (Rade).

2.

View of Place Bel-Air and the Island (l'Isle), Christian Gottlieb Geissler, 1802, reproduction of an engraving, Geneva Library collection (Centre d'icnographie genevoise).

3.

Rocking swan made by the Swiss company Wisa-Gloria between 1943-1952.

PEUT-ON CHASSER LES CORMORANS ?

Depuis 2017, les grands cormorans, peuvent être à nouveau chassés sur la partie vaudoise du lac, après avoir été mis sous protection entre 2011 et 2016. A l'avenir, la législation pourrait encore changer.

Ailleurs sur le Léman, les trois espèces de cormorans observables en Suisse sont en sécurité, car la chasse est interdite à Genève depuis 1974 et sur la partie valaisanne du lac depuis 1975. Côté français, les cormorans sont protégés depuis 1979. La Haute-Savoie autorise néanmoins des tir de régulation (environ 80 grands cormorans) y sont abattus chaque année.

Pour de nombreux pêcheurs, les cormorans posent souvent problème. Ils leur reprochent leur appétit et les dégâts qu'ils font sur les poissons pêchés et les filets de pêche.

L'augmentation du nombre de cormorans sur le Léman inquiète leurs adversaires. Alors qu'ils n'étaient qu'une dizaine dans les années 1930, les cormorans étaient près de 1300 en 2014. Cette augmentation s'explique notamment par la protection décidée en 1977 par la Communauté Economique Européenne.

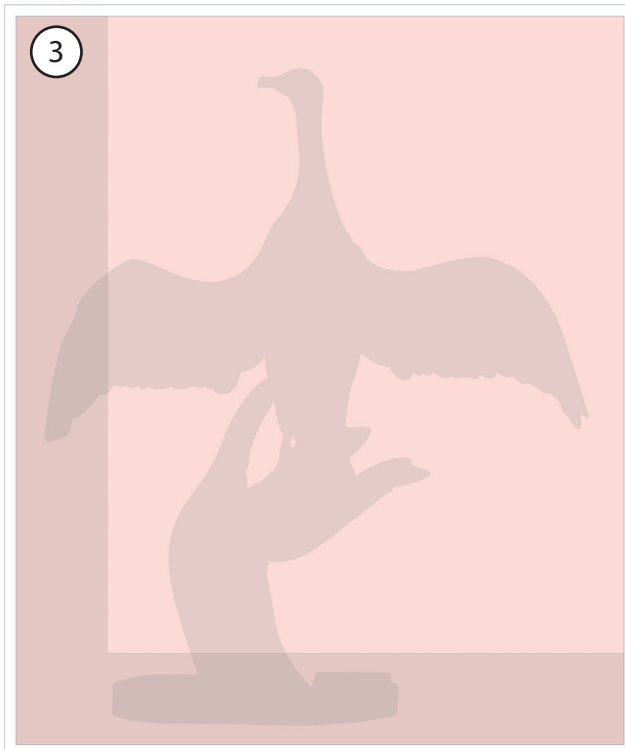
Plus nombreux, les cormorans changent aussi leur comportement. Autrefois présents sur le Léman pour hiverner, ils y nichent depuis 2010, notamment dans la réserve des Grangettes.



© Illustration de Tom Tirabosco, 2016, reproduction de la gravure de la notice de la "Wanted! Hunting on the Lake" exhibition (14 April 2016-8 January 2017).



© Orca Production, 2017, documentaire de la série "Biosphère" durée 8 minutes 40.



© Illustration de Tom Tirabosco, 2016, reproduction de la gravure de la notice de la "Wanted! Hunting on the Lake" exhibition (14 April 2016-8 January 2017).

Can cormorants be hunted?

Since 2017, it is again possible to hunt Great Cormorants, protected from 2011 to 2016, in the Vaud sector of the Lake. The law may change again in the future. Elsewhere on Lake Geneva, the three species of cormorant observed in Switzerland are safe, since there has been a ban on hunting them in Geneva since 1974 and in the Valais sector of the Lake since 1975. On the French side, cormorants have been protected since 1979. However, Haute-Savoie permits controlled hunting (approximately 80 Great Cormorants are shot annually). Many fishermen consider that cormorants frequently pose problems on account of their appetite and the damage they do to the fish taken and to fishing nets. The increase in the number of cormorants on Lake Geneva is a concern to those who oppose their existence. In the 1930s there were only a dozen or so, but nearly 1300 in 2014. The increase can be explained for the most part by the European Economic Community's decision to protect them in 1977. Now that there are more of them, the behaviour of the cormorants has also changed. Where once they only spent their winters on Lake Geneva, they have now been nesting there since 2010, especially in the Grangettes nature reserve.

1. The Cormorant, as seen by Tom Tirabosco, 2016, reproduction of a drawing. Detail of the poster for the "Wanted! Hunting on the Lake" exhibition (14 April 2016-8 January 2017).
2. The Great Cormorant, Orca Production, 2017, documentary from the "Biosphère" series, duration 8 minutes 40.
3. Stuffed Great Cormorant (*Phalacrocorax carbo*), wings open. This position enables the bird to dry its wings but is essentially to speed up digestion.



Le Père Vengeron Louis Kunz, end 19th century. This photograph is of Mr. Borgognon, otherwise known as Père Vengeron. He worked in the fish farm belonging to the Parisian fashion designer Jean-Philippe Worth, who took up residence in the mansion known as the "Château de Promenthoux" in Prangins. In 1905, Worth made a gift of 6 000 alevins to the Canton of Vaud to restock the Promenthouse (the river flowing into Lake Geneva at Prangins). The following year he gifted a further 10 000.

Y A-T-IL ENCORE DE LA FÉRA DANS LE LAC ?

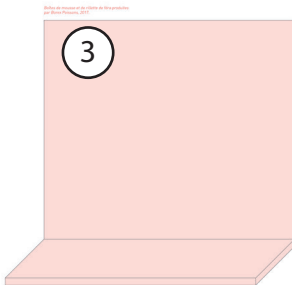
La féra était l'une des espèces appartenant au genre des coregones et à la famille des salmonidés. Poisson indigène du Léman, dont la présence est attestée par un document qui détaille la taxe sur les grés des poissons vendus en 1376, elle a progressivement disparu du lac dans les années 1920. Les causes de sa disparition ne sont pas clairement établies. Mais l'absence de régulation de la pêche à l'époque et l'exploitation des filets de "grand pic" y ont sans doute fortement contribué. En 1923, on estimait que les captures de féras avaient baissé de 99% au cours des 25 dernières années.

Pour suppléer à la disparition de la féra, on se tourne dès 1902 vers la pisciculture. Les Français réintroduisent des alevins d'un autre coregone, le lavaret du lac du Bourget, alors que les Suisses utilisent un coregone du lac de Neuchâtel, la paléa, et même en 1928 des marines du lac Peïpus en Estonie.

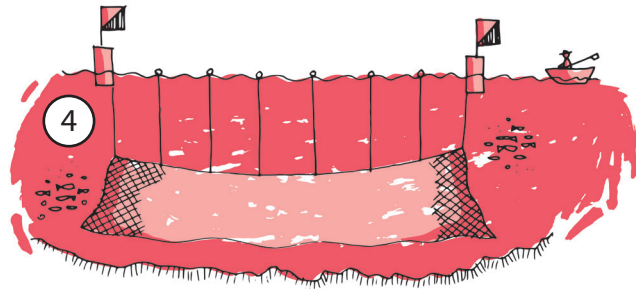
Grâce à ces interventions, on observe rapidement une augmentation des effectifs. Comme les différentes espèces introduites se sont hybridées entre elles, il vaut mieux parler aujourd'hui simplement de coregone, même si l'appellation féra reste utilisée dans le langage courant.



2. La féra (Coregonus fera), Godefroy Lunel, 1869, illustration from the monograph Histoire naturelle des poissons du Léman. In the 19th century, the whitefish was known as "fisherman's bread" since alone it accounted for 50% of the catch from the Lake. Today, it is once more the species most fished in Lake Geneva (in 2014 a record 976 tonnes).



3. Tins of whitefish mousse and rillettes produced by Borex Poissons, 2017.



4. La pêche au "grand pic", studio KO, 2018, a drawing inspired by the work of Antoine Lugin. The "grand pic", invented in 1896, is a drift net 120 metres long and 15 to 20 metres high. The net is set at sunset and taken up at dawn after drifting with the currents, with a black flag at one end and a lantern at the other as markers.

Are there still whitefish in the Lake?

Whitefish (féra) was one of the species of the Coregonus genus and the Salmonidae family. A native of Lake Geneva, its presence attested in a document detailing the tax on the price of fish sold in 1376, it gradually disappeared from the Lake in the 1920s. The causes of this have not been clearly established, although the lack of any regulation of fishing at the time and the use from 1888 onwards of a "grand pic" drift net no doubt contributed to a large extent to its disappearance. In 1923 it was estimated that whitefish capture had declined by 99% over the previous 25 years.

In order to compensate for the disappearance of the whitefish, fish-farming was introduced from 1902. The French reintroduced alevins of another coregonine, the lavaret from the Lac du Bourget, while the Swiss used a coregonine from the Lake Neuchâtel, Coregonus palaea, and in 1928 even brought in Lake Peïpus whitefish, Coregonus maraenoides, from Estonia. A rapid increase in numbers was observed as a result of these actions. Since hybridisation has taken place among the different species introduced, it is simpler today to refer generally to whitefish, although the term féra is still commonly used.

1. Le Père Vengeron, Louis Kunz, end 19th century. This photograph is of Mr. Borgognon, otherwise known as Père Vengeron. He worked in the fish farm belonging to the Parisian fashion designer Jean-Philippe Worth, who took up residence in the mansion known as the "Château de Promenthoux" in Prangins. In 1905, Worth made a gift of 6 000 alevins to the Canton of Vaud to restock the Promenthouse (the river flowing into Lake Geneva at Prangins). The following year he gifted a further 10 000.
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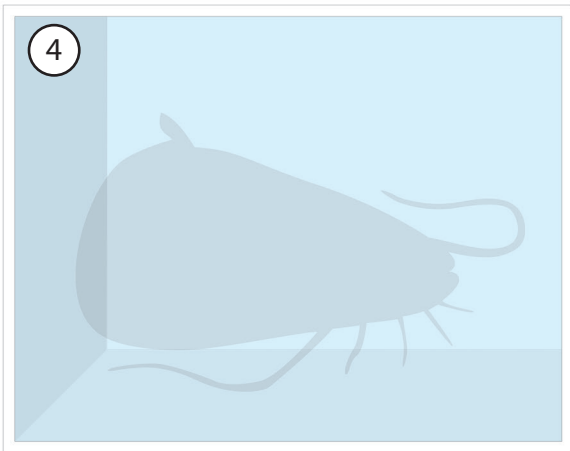
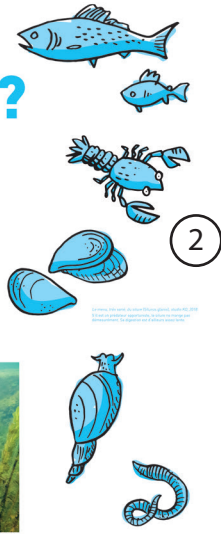
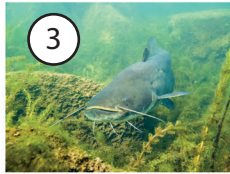
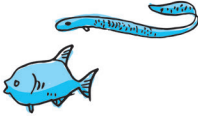
PEUT-ON SE FAIRE MORDRE PAR UN SILURE ?



Le silure est l'un des rares poissons d'Europe qui mord parfois des baigneurs. En Suisse, des cas ont été signalés dans le lac de Neuchâtel ou en Valais, mais pas encore dans le Léman.

Il peut avaler des proies mesurant un tiers de sa taille. Son menu se compose généralement de poissons, y compris de ses congénères, d'œufs, d'écrevisses, voire d'oiseaux aquatiques. C'est un opportuniste vivant près du fond, caché dans l'attente de ses proies.

Le silure n'est pas un poisson indigène du Léman. Originaire du bassin du Rhin et du Danube, sa présence dans le lac pourrait s'expliquer par l'installation de nouvelles passes à poissons au fil du Rhône ou par des lâchers de pêcheurs en quête de sensations fortes. Il semble se plaire dans le Léman, puisque sa capture est en augmentation depuis trois à quatre ans et que selon des études récentes il aurait commencé à s'y reproduire.



Can you be bitten by a catfish?

The catfish is one of the rare fishes in Europe that sometimes bites swimmers. In Switzerland, there have been cases in the Lake Neuchâtel and in Valais, but not so far in Lake Geneva. The fish can consume preys a third of its own size. Its menu generally comprises fish, including members of its own kind, eggs, crayfish and even water birds. Living near the bottom of the Lake, it is an opportunist that lies in wait for its prey. The catfish is not native to Lake Geneva but comes from the Rhine and Danube basin. Its presence in the Lake can be attributed to the installation of new fish ladders along the Rhone or to thrill-seeking fishermen releasing individuals into the Lake. It seems at home in Lake Geneva, since there has been an increase in captures over the last three or four years and according to recent studies it has apparently begun to breed.

1. Headline, Tribune de Genève, 14 October 2017. The fisheries act specifies that all catfish caught in the Rhone or Lake Geneva must be taken out of the water and recorded in the fishing log.
2. The catfish (*Silurus glanis*) menu and its great variety, studio KO, 2018. Although it is an opportunistic predator, the catfish is not a glutton, and in fact its digestive process is slow.
3. Catfish (*Silurus glanis*), Rémi Masson, 2009. It has not yet been decided whether or not this species is a danger to the Lake Geneva ecosystem.
4. Head of a stuffed catfish (*Silurus glanis*) fished in Lake Constance, Christian Schneider, taxidermy, 2018.

PRODUIRA-T-ON UN JOUR DU CAVIAR DU LÉMAN ?

Entre 1993 et 1994, sept esturgeons sont pêchés dans le Léman, trois du côté français, quatre dans la partie suisse. On s'interroge : D'où viennent-ils ? Comment se sont-ils retrouvés ici ? Les esturgeons vont-ils coloniser le lac ? Peut-on espérer une production de caviar lémanique ?

Pour les spécialistes, une chose est sûre : ces sept esturgeons ne sont pas arrivés seuls dans le Léman. Ils soupçonnent un particulier qui aurait profité du lac pour voler son aquarium ou une pisciculture qui aurait laissé échapper quelques-uns de ses pensionnaires.

Depuis, à l'exception de deux spécimens pêchés en 2007 et 2014, le Léman ne semble pas avoir hébergé d'autres esturgeons. Il est donc très peu probable que le lac abrite un jour suffisamment d'esturgeons pour qu'une production de caviar puisse se développer. En revanche, certains pêcheurs produisent déjà du caviar du lac à partir d'œufs de corégones ou de brochets.



Photo anonyme / musée de la Ville de Genève, collection Jean-Pierre Canova



Illustration publiée dans la "Tribune de Genève" pour illustrer l'article de Pierre Raymond sur "pêcheurs découvrant du caviar en Lac Léman", 30 novembre 1993.

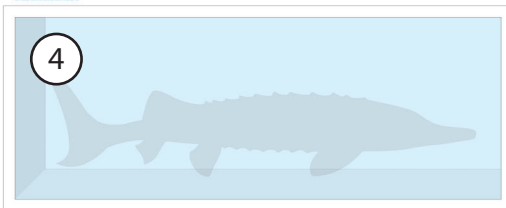
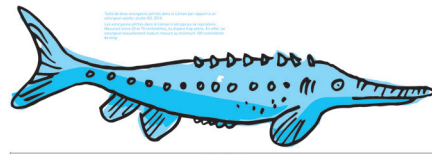
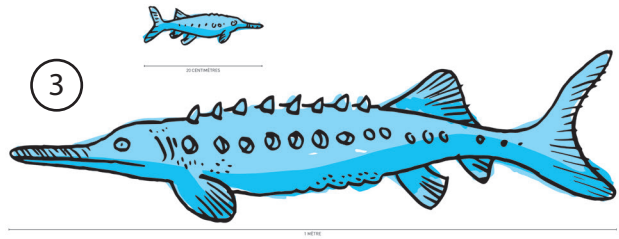


Illustration publiée dans la "Tribune de Genève" pour illustrer l'article de Pierre Raymond sur "pêcheurs découvrant du caviar en Lac Léman", 30 novembre 1993.



Will there be Lake Geneva caviar some day?

Seven sturgeons were fished in Lake Geneva between 1993 and 1994 – three on the French side, four in the Swiss sector. There were questions. Where did they come from? How did they get here? Will they become established in the Lake? Can we look forward to a Lake Geneva caviar? One thing is certain for the specialists: the seven sturgeons did not arrive in Lake Geneva of their own accord.

The suspicion is that a private individual may have taken advantage of the Lake to clear out his aquarium or that a fish farm may have let some of the inmates escape.

Since then, with the exception of two specimens fished in 2007 and 2014, Lake Geneva does not seem to have hosted any other sturgeons. It therefore seems very unlikely that there will one day be sufficient numbers of sturgeons in the Lake for caviar production to develop. Some fishermen, however, have already produced lake caviar from whitefish or pike eggs.

1. Sturgeon hanging from the Eaux-Vives crane in Geneva, an anonymous photograph from the 1950s, Jean-Pierre Canova collection. According to the investigation conducted by the owner of the photo, this sturgeon seems not to have been fished in Lake Geneva. This is corroborated by the impressive size of the fish.
2. Drawing published in the "Tribune de Genève" to illustrate the article by Pierre Raymond on "fishermen discovering caviar in Lake Geneva", 30 November 1993.
3. Sturgeon (*Acipenser sturio*) approximately three years old fished in Lake Geneva in 1994, Christian Schneider, taxidermy, 2018
4. Size of two sturgeons fished in Lake Geneva compared with an adult of the species, studio KO, 2018. The Lake Geneva sturgeons could not have bred - at between 20 and 70 centimetres they were too small. A sexually mature sturgeon is at least 100 centimetres long.

Y-A-T-IL DES MÉDUSES DANS LE LAC ?

1


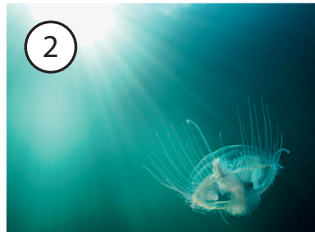


Photo de Henri de Genève-Lautrec, Musée cantonal de zoologie, Thonon-les-Bains, 1962

En 2004, une méduse est capturée à Noville dans le port du Vieux-Rhône et photographiée par le Musée cantonal de zoologie. Cet événement, qui s'est également produit en 2006 à Thonon-les-Bains, avait déjà fait l'objet d'une observation en 1962.

2



Plus qu'une méduse, cet animal est en réalité une des phases du développement d'un petit organisme vivant: le polype. Celui-ci atteint cette étape lorsque la température de l'eau dépasse les 25°C. Importé d'Asie du sud-est, cet animal est arrivé avec des plantes aquatiques destinées à décorer des étangs et des jardins et s'est faie le long des eaux littorales.

Comme ses consœurs maritimes, la méduse d'eau douce a un estomac central en forme de vase échancre, quatre longs tentacules et une centaine de petits, munis des cellules urticantes. De petite taille, 2 centimètres au maximum, elle ne devrait pas causer de problèmes de santé publique; ce polype est peu présent dans le Léman et son espérance de vie sous sa forme adulte n'excède pas une dizaine de jours.

Photo de Henri de Genève-Lautrec, Musée cantonal de zoologie, Thonon-les-Bains, 1962

4

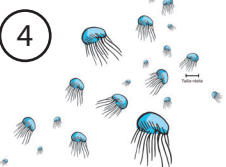


Photo de Henri de Genève-Lautrec, Musée cantonal de zoologie, Thonon-les-Bains, 1962

3




Photo de Henri de Genève-Lautrec, Musée cantonal de zoologie, Thonon-les-Bains, 1962




Photo de Henri de Genève-Lautrec, Musée cantonal de zoologie, Thonon-les-Bains, 1962

Are there jellyfish in the Lake?

In 2004 a jellyfish was caught in the Vieux-Rhône harbour, Noville, and photographed by the Cantonal Museum of Zoology. This also happened in 2006 at Thonon-les-Bains and had already been observed in 1962. Rather than an actual jellyfish, the creature is in fact one of the development phases of a small living organism, or polyp. It reaches this stage when the water temperature is over 25°C. It was imported from South-East Asia along with aquatic plants for decorating ponds and gardens and settled along the shores of the Lake. Like its maritime relatives, the freshwater jellyfish has a central stomach shaped like an indented bowl, four long tentacles and some hundred smaller ones containing stinging cells. They are small, 2 centimetres across at most, and unlikely to be a public health problem; the polyps are not common in Lake Geneva and their life expectancy as adults is not more than about ten days.

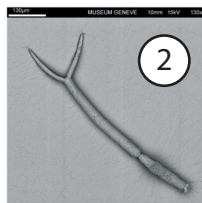
1. A literally dumbfounded ("médusé") Henri de Genève-Lautrec, Plonk et Replonk, 2008. Old postcard revamped for the "La face cachée du Léman" exhibition.
2. Freshwater jellyfish (*Craspedacusta sowerbii*) photographed in a meander of the Rhone, Rémi Masson, 2010.
3. Freshwater jellyfish (*Craspedacusta sowerbii*) in the polyp stage, photographed in Lake Geneva, Peter Schuchert, 2013, Geneva Natural History Museum.
4. Stranded freshwater jellyfish (*Craspedacusta sowerbii*), life size, studio KO, 2018.

LES PUCES DE CANARD PEUVENT-ELLES SAUTER ?

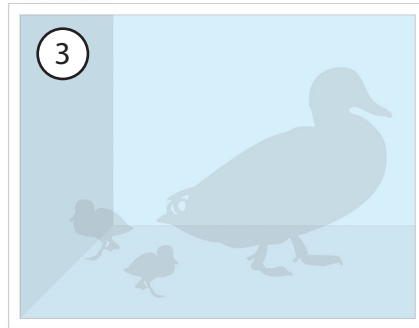
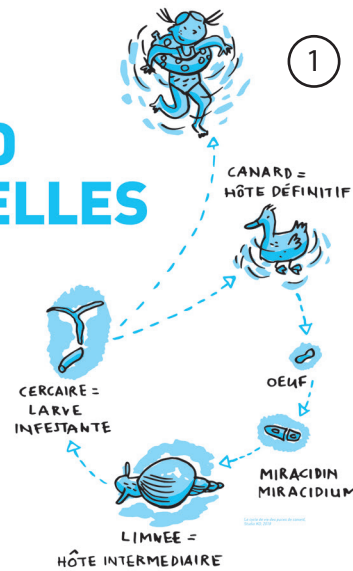
Les puces de canard portent bien mal leur nom. Contrairement aux véritables puces, elles ne sautent pas, mais se déplacent dans l'eau. Il s'agit en réalité de vers trématodes microscopiques.

Leur cycle naturel commence par la ponte d'un œuf dans l'organisme d'un oiseau aquatique. Expulsé en même temps que les déjections de l'oiseau, l'œuf se retrouve ensuite dans l'eau. Lorsqu'il éclot, de minuscules larves en sortent pour s'implanter dans des escargots d'eau vivant dans le fond du lac. Elles se transforment ensuite en vers plats d'environ 0,5 millimètre et quittent les escargots qui les aident à la recherche d'oiseaux aquatiques sur lesquels elles deviendront adultes. Elles pourront alors y pondre et permettre le commencement d'un nouveau cycle.

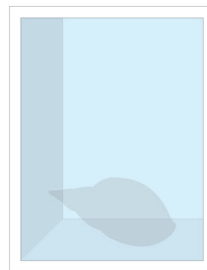
Parfois, les puces de canard se trompent de cible et s'attaquent à un baigneur. Incapables de se développer dans l'organisme humain, elles y meurent. Chez le baigneur parasité, une réaction cutanée et des démangeaisons s'ensuivent. C'est pourquoi, au lieu de « puces de canard », on parle parfois de « dermatite du baigneur ».



NON, ELLES SE DÉPLACENT DANS L'EAU



④



Can duck fleas jump?

Duck fleas do not live up to their name; unlike true fleas, they do not jump but move through water.

They are in fact microscopic trematode worms. The cycle starts with an egg laid in the organism of a water bird. The egg is evacuated into the water along with the bird's excrement. When it hatches it releases minute larvae which implant in water snails living on the lake bottom. They then transform into flatworms approximately 0.5 millimetres long and abandon the host snails in search of water birds, developing into adults inside them. They can then lay eggs and start a new cycle.

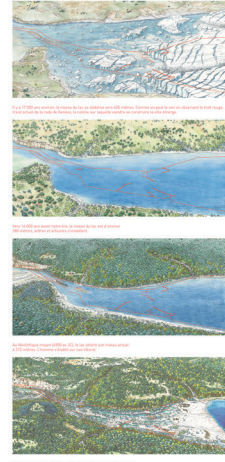
Duck fleas sometimes miss their target and attack swimmers. Since they cannot develop in a human organism they die. When the parasites infect a swimmer a skin reaction and itching result. This why the condition is sometimes referred to as "swimmer's itch" rather than "duck fleas".

1. The life cycle of duck fleas, Studio KO, 2018.
2. Trematode worm (*Trichobilharzia* sp.), photographed with a scanning electron microscope, Isabel Blasco Costa, 2018, Geneva Natural History Museum.
3. Stuffed mallards (*Anas platyrhynchos*), female and chicks. Trematode worms do not represent a lethal risk to mallards, but their presence may cause decreased energy, breathing difficulties and various types of lesion.
4. Freshwater snail shells (left) and live snails (right) (*limnaea auricularia* and *pellagra*). Since these snails are very common in freshwater environments, many parasites have selected them as interim hosts.

1

QUI A CRÉÉ LE LAC ?

PAYSAGE DE LA RADE DE GENÈVE, EN QUATRE ÉTAPES APRÈS LE RETRAIT GLACIAIRE.



Le glacier du Rhône a donné naissance au Léman. Par différents mécanismes d'érosion, il a creusé la roche et créé le bassin du lac. Ce bassin a ensuite été en partie comblé par des sédiments laissés par le glacier au moment de son recul.

Les plus anciennes traces de glaciation identifiées dans la région datent d'environ 800 000 ans. Depuis, les glaciers alpins ont connu de nombreux reculs et avancées en lien avec les glaciations. La dernière extension maximale du glacier du Rhône s'est déroulée il y a environ 23 500 ans. Il s'étendait alors jusque dans la région de Lyon et formait un volume considérable (au-dessus de l'accroche Genève, le glacier atteignant 1 200 mètres de haut). Son recul définitif s'est produit il y a environ 18 000 ans et c'est seulement 8 000 ans plus tard que le lac a atteint son niveau actuel.

Dans la mythologie populaire, la naissance du lac est envisagée autrement. Une légende l'attribue au géant Gargantua qui, voulant prendre un bain, aurait agrandi le lit du Rhône. Avec la terre amassée, il aurait créé le Mont Salève (le nom viendrait de l'exclamation des lémanois «ça lève»). Une autre légende raconte que le Léman serait l'œuvre d'un ange. Chargé de surveiller la région, celui-ci aurait abondamment pleuré lorsque Dieu l'envoya ailleurs pour une autre mission. Ses larmes auraient donné naissance au lac.

Illustrations publiées dans le livre "Des Alpes au Léman: images de la préhistoire" (From the Alps to Lake Geneva: images of prehistory), by Alain Galay, published in 2006 by Editions Infolio.

LE GLACIER DU RHÔNE



Who created the Lake?

It was the Rhone glacier that gave rise to Lake Geneva. Different erosion mechanisms carved out the rock and created the lake basin, which was subsequently filled in by the sediments left behind by the glacier as it receded. The oldest traces of glaciation that have been identified in the region go back to around 800 000 years ago. Since then, the Alpine glaciers have advanced and retreated many times as glaciations have come and gone. The most recent maximum advance of the Rhone glacier took place around 23 500 years ago, when it extended as far as the Lyon region and attained a considerable volume (the glacier was 1 200 metres thick over where Geneva now stands). Its final retreat took place about 18 000 years ago and it was only 8 000 years later that the Lake reached its present level. Popular mythology has another explanation for the origins of the Lake. A legend attributes its creation to the giant Gargantua who wanted to take a bath and widened the bed of the Rhone. With the accumulated earth he is said to have created the Salève (an exclamation from the onlookers: "ça lève" – it rises up, allegedly provided a name for it). Another legend relates that Lake Geneva was the work of an angel. The angel was responsible for overseeing the region, and was said to have wept abundantly when God sent him away on another mission. The Lake was created from his tears.

1. PAYSAGE DE LA RADE DE GENÈVE, EN QUATRE ÉTAPES APRÈS LE RETRAIT GLACIAIRE (Environ of the Geneva harbour area in four stages after the retreat of the glaciers). Illustrations published in the book "Des Alpes au Léman: images de la préhistoire" (From the Alps to Lake Geneva: images of prehistory), by Alain Galay, published in 2006 by Editions Infolio.

Around 17 000 years ago, the level of the Lake stabilised at about 405 metres. If you look at the red line outlining Geneva's present harbour area (rade), the hill on which the town was to be built stands out. About 14 000 years before our time, the level of the Lake was approximately 380 metres, and trees and bushes were taking root. In the mid-Neolithic (4900 BC), the Lake reached its present level of 372 metres. Humans settled on its shores. In the Late Bronze Age (1000 BC) during periods of low water, the water level was 3 metres lower than today and no longer flowed. Several villages were established on the banks.

LE NANT D'AISSY LE WANNA/BACH
 le mercure la Raspille
 LE VEYRON le flon LA BERGÈRE
 l'Assè Le Rhône L'ABOYEU
 l'hermance LA BORGNE LE COE TAPAUDEZE
 le Rupalet DE STOCKALPER
 LA FESCHILLISU LE LOS e Aubonne LA DEISCHBACH
 la navisense
 l'aversoix

D'OÙ PROVIENT L'EAU DU LAC ?

1



Embranchement de la Dranse, Charles Barbant, vers 1870, reproduction d'un tirage en couleurs de l'Album pittoresque d'un voyage en Suisse - Le Léman.

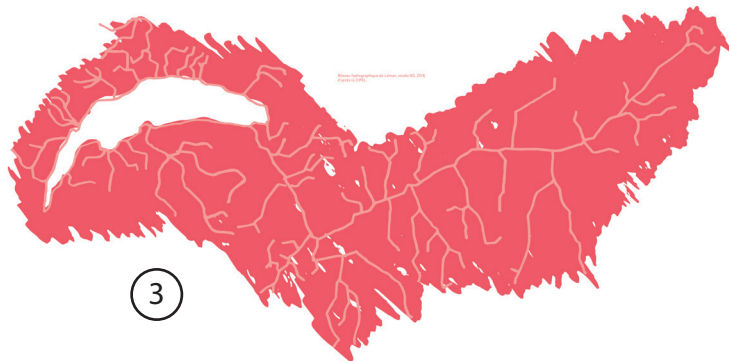
Le bassin versant du Léman s'étend sur un territoire de 7999 km². Il recueille les flots d'un réseau de 315 cours d'eau qui convergent vers le lac. Ces ruisseaux et ces rivières, qui selon les lieux sont appelés nants, biefs, flons ou rios, se jettent dans le lac ou rejoignent l'un de ses quatre principaux affluents. À eux seuls, le Rhône, la Dranse, la Venoge et l'Aubonne fournissent plus de 75% de l'apport total des 89 km³ d'eau du Léman.

Mais si le Léman est aussi alimenté par les pluies, pour une moyenne annuelle d'environ 1030 millimètres par cm² d'eau, un mystère demeure. Le volume d'eau qui sort du lac pour se jeter dans le Rhône à Genève est plus important que la somme des eaux qui y entrent par les précipitations et les affluents. D'où viennent ces 6 à 8 m³ d'eau par seconde, l'équivalent de 30 à 40 baignoires ? Probablement du cumulé des eaux qui ruissellent depuis les rives, de l'apport de petits affluents dont le débit n'est pas mesuré, et peut-être de sources sous-lacustres.

2



Hydrographie du Léman, studio KO, 2018, basé sur CIPTEL.



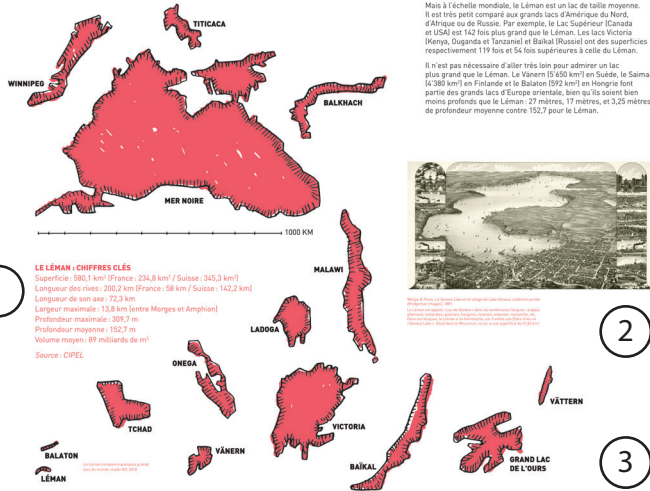
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Where does the lake water come from?

Lake Geneva's catchment area extends over a territory of 7 999 km². It receives water from a network of 315 waterways which converge on the Lake. These streams and rivers (locally referred to as nants, biefs, flons or rios) flow into the Lake or into one of its four main tributaries. The Rhone, the Dranse, the Venoge and the Aubonne alone furnish over 75% of the total inflow to the 89 km³ of water in Lake Geneva. Although Lake Geneva is also fed by rain – an annual average of some 1 030 millimetres per cm² of water – there is still a mystery. The volume of water leaving the Lake for the Rhone at Geneva is greater than the total volume of water reaching the Lake as precipitation or from the tributaries. Where do these 6 to 8 m³ of water per second, the equivalent of 30 to 40 bathtubs, come from? The answer is that this volume probably derives from the accumulated water running off the banks and the contribution of small tributaries where the flow is not measured, or perhaps also from springs under the Lake.

1. Embouchure de la Dranse (Mouth of the Dranse), Charles Barbant, around 1870, reproduction of a tinted print in the "Album pittoresque d'un voyage en Suisse - Le Léman".
2. Cette fameuse rivière (This famous river), RTS (Swiss Television and Radio) Archive, 31 December 1962. Duration: 3 minutes 48. Jean-Villard Gilles, actor and chansonnier, accompanied on the piano by his partner Albert Urfer, lovingly personifies the Venoge, the river flowing through his beloved Vaud countryside. Poem written in 1954.
3. Hydrographic network of Lake Geneva, studio KO, 2018, based on CIPTEL.

LE LÉMAN EST-IL UN GRAND LAC ?



1 LE LÉMAN - CHIFFRES CLÉS
 Surface: 580,1 km² (France: 234,8 km² / Suisse: 345,3 km²)
 Longueur des rives: 220,2 km (France: 58 km / Suisse: 142,2 km)
 Longueur de son axe: 72,3 km
 Profondeur maximale: 13,8 km (entre Morges et Amphion)
 Profondeur moyenne: 309,7 m
 Profondeur moyenne: 152,7 m
 Volume moyen: 89 milliards de m³
 Source: CIPEL

Le Léman est le plus grand lac d'Europe occidentale. Grâce à sa superficie de 580,1 km², il pourrait contenir ensemble les villes de Paris (105,4 km²), Milan (181,8 km²), Barcelone (101,9 km²), Lisbonne (100 km²) et Zurich (87,88 km²). Le Léman se distingue aussi par son importante profondeur qui lui permettrait d'englober complètement la Tour Eiffel (sans son antenne).
 Mais à l'échelle mondiale, le Léman est un lac de taille moyenne. Il est très petit comparé aux grands lacs d'Amérique du Nord, d'Asie ou de Russie. Par exemple, le Lac Supérieur (Canada et USA) est 142 fois plus grand que le Léman. Les lacs Victoria (Kenya, Ouganda et Tanzanie) et Baïkal (Russie) ont des superficies respectivement 119 fois et 54 fois supérieures à celle du Léman.
 Il n'est pas nécessaire d'aller très loin pour admirer un lac plus grand que le Léman. Le Vänern (5 650 km²) en Suède, le Saimaa (4 380 km²) en Finlande et le Balaton (592 km²) en Hongrie font partie des grands lacs d'Europe orientale, bien qu'ils soient bien moins profonds que le Léman: 27 mètres, 17 mètres, et 3,25 mètres de profondeur moyenne contre 152,7 pour le Léman.



© CIPEL - Université de Lausanne



© Jean Guareschi, 1948

Is Lake Geneva a big lake?

Lake Geneva is the biggest lake in Western Europe. With a surface area of 580.1 km² it could contain the cities of Paris (105.4 km²), Milan (181.8 km²), Barcelona (101.9 km²), Lisbon (100 km²) and Zurich (87.88 km²) together. Another distinguishing feature is its considerable depth; it could completely engulf the Eiffel Tower (without the antenna).

At world level, however, Lake Geneva is an average-sized lake. Compared with the huge lakes of North America, Africa or Russia, it is very small. For example, Lake Superior (Canada and the USA) is 142 times bigger than Lake Geneva, while Lake Victoria (Kenya, Uganda and Tanzania) and Lake Baïkal (Russia) have surface areas respectively 119 times and 54 times greater. There is no need to travel far to admire a lake that is bigger than Lake Geneva.

Vänern in Sweden (5 650 km²), Saimaa in Finland (4 380 km²) and Balaton in Hungary (592 km²) are some of the biggest lakes in Eastern Europe, although they are much shallower than Lake Geneva, at average depths of 27 metres, 17 metres and 3.25 metres, respectively, compared with Lake Geneva's average depth of 152.7 metres.

1. LAKE GENEVA: KEY FIGURES

- Surface area: 580.1 km² (France: 234.8 km²/Switzerland: 345.3 km²)
- Shore length: 220.2 km (France: 58 km/Switzerland: 142.2 km)
- Length of main axis: 72.3 km
- Maximum breadth: 13.8 km (between Morges and Amphion)
- Maximum depth: 309.7 m
- Average depth: 152.7 m
- Average volume: 89 billion m³
- Source: CIPEL

2. Wellge & Poole, Lake Geneva and Lake Geneva Village, private collection (Bridgeman Images), 1881. "Lac Léman" is known as "Lake Geneva" in various languages: English, German, Dutch, Polish, Hungarian, Romanian, Estonian, Romansh, etc. In these languages Lake Geneva has a homonym, since there is a Geneva Lake in the United States, located in Wisconsin, with a surface area of 21.86 km².

3. Lake Geneva compared with some big lakes worldwide, studio KO, 2018.

4. Relief map of the Lake bottom, Jean Guareschi, 1948. This model, by a first-year student of the Collège scientifique cantonal (Cantonal science college) shows the relief of the Lake bottom.

MAIS OÙ EST PASSÉ LE RHÔNE ?

1

Photo de La Bataillère prise d'un avion de ligne suisse
L'année de la photo n'est pas connue. On voit cependant
l'ancien pont de la Bataillère et le Rhône qui se jette dans
le lac Léman. On voit également les canyons du Rhône
immergés sous l'eau du lac Léman.

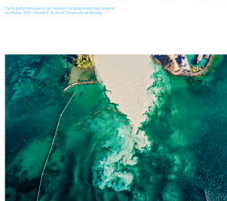
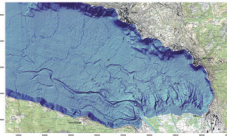
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Selon l'historien du 4^e siècle Ammien Marcellin, le Rhône « se jette dans un lac nommé Léman qu'il traverse sans se confondre jamais avec lui ». Cette croyance perdura de nombreux siècles. En 1730, l'ingénieur Jean-Christophe Fatio de Duillier la réfute, car cela « est tellement opposé aux règles de la pesanteur et de l'équilibre des liqueurs, que la chose est absolument impossible ».

Cependant, cette croyance avait un fond de vérité, car l'eau du Rhône est plus froide et plus dense que celle du lac (en raison de sa température et des sédiments qu'elle transporte). C'est pourquoi, elle plonge et s'écoule comme une rivière le long de la pente du lac et ne se mélange que petit à petit avec l'eau de celui-ci. Après un parcours sous-aquatique de 12-13 kilomètres, l'eau du Rhône finit de se mélanger avec celle du lac.

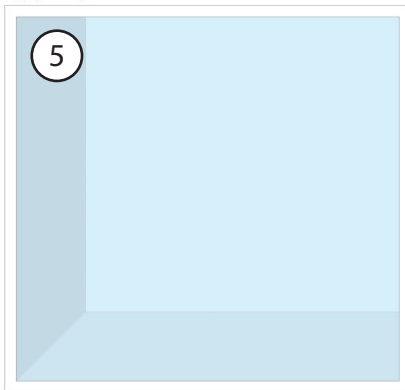
Ce phénomène explique l'existence de véritables canyons immergés : un principal et huit autres qui témoignent d'anciennes embouchures du Rhône, avant que le fleuve ne soit endigué et canalisé à la fin du 19^e siècle.

3



4

5



But where did the Rhone go?

According to the 4th century historian Ammianus Marcellinus the “Rhone flows into a lake called Lemanus and flows through it without ever mixing with it”. This belief held sway for many centuries. In 1730, the engineer Jean-Christophe Fatio de Duillier rejected it on the grounds that “it is so contrary to the laws of gravity and the balance of liquids that it is absolutely impossible”. The belief did, however, have a modicum of truth, since the water of the Rhone is colder and denser than that of the Lake (because of its temperature and the sediments it carries). This is why, on entering the Lake it flows like a river along the lake slope and only mixes little by little with its water. After flowing underwater for 12-13 kilometres, the Rhone ends up mixing with the water of the Lake. This phenomenon explains the existence of veritable submerged canyons – one main one and another eight attesting to earlier mouths of the Rhone, before the river was dyked and channelled in the late 19th century.

1. View of La Bataillère from a Swiss national company plane, author unknown, 1936, Swissair AG Zurich. This phenomenon is mainly visible in summer, when the temperature variation between the river, swollen with snowmelt, and the Lake, heated by the sun, is at its greatest.
2. Développement du Rhône, du Saint-Gothard à la Mer, illustration from the book “Le Rhône. Histoire d'un fleuve”, by Charles Lenthéric (1892). On the maps the Rhone disappears at Villeneuve and re-emerges at Geneva.
3. Bathymetric chart of the Lake showing the location of the canyons of the Rhone, 2009, Institut F.-A. Forel, University of Geneva.
4. La Bataillère, David Carlier, July 2018, photographed from a paraglider. The point where the Rhone enters Lake Geneva lives up to its name: La Bataillère. The grey river, weighed down by its low temperature and the load of its alluvial deposits, comes up against the warm blue waters of Lake Geneva, into which it plunges headlong, eddying and swirling.
5. Le Rhône, André Vermare, 1902, collection Didier Zuchuat. This bronze sculpture represents a fragment of the relief “Le Rhône et la Saône” which decorated the Palais du Commerce in Lyon from 1905 on. It is the model for a figurehead to be sculpted in 2019 for the paddle steamer RHÔNE III. The vessel was launched on Lake Geneva in 1927 and lost its figurehead in a collision in 1928, a fortnight after being brought into regular service.

PEUT-ON OBSERVER DES MARÉES DANS LE LAC ?



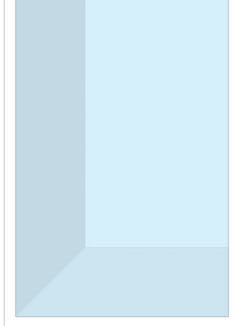
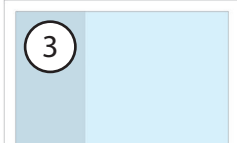
Le Léman est trop petit pour que de véritables marées puissent se former. Pourtant il n'est pas rare d'y observer de brusques élévations momentanées du niveau de l'eau parfois de plus d'une trentaine de centimètres. En 1730, l'ingénieur genevois Jean-Christophe Fatio de Duillier rapporte que les riverains nomment ces étranges phénomènes seiches.

La première véritable explication est apportée par le savant genevois Jean-Pierre-Etienne Vaucher en 1803. Il démontre que les seiches surviennent lors de variations brusques de la pression atmosphérique. Ces différences de pression génèrent des vents poussant les eaux d'un point à l'autre du lac. Le niveau d'eau s'élève dans la région où la pression est la plus basse et au contraire s'abaisse là où elle est la plus haute. Quand le vent cesse, les eaux retournent à l'équilibre par un lent mouvement de balancier décroissant.

Le savant François-Alphonse Forel démontrera un demi-siècle plus tard l'existence de deux types de seiches sur le Léman: les seiches longitudinales oscillant entre Villeneuve et Genève et les seiches transversales entre Morges et la côte savoyarde. On découvrirait par la suite que le lac connaît aussi des seiches internes. Également provoquées par les vents, celles-ci affectent la thermocline (limite entre les eaux chaudes de surface et les eaux froides plus profondes). Lors de forts vents en été, cette thermocline bascule et provoque des courants d'eau à moyenne profondeur.



Le savant François-Alphonse Forel démontrera un demi-siècle plus tard l'existence de deux types de seiches sur le Léman: les seiches longitudinales oscillant entre Villeneuve et Genève et les seiches transversales entre Morges et la côte savoyarde.



Can one see tides in the Lake?

Lake Geneva is too small for true tides to form. It is not uncommon, however, to see strange short-lived upsurges in water level of sometimes thirty centimetres or more. In 1730, the Geneva engineer Jean-Christophe Fatio de Duillier reported that the locals called these odd events “seiches” (standing waves). The Geneva scientist Jean-Pierre-Etienne Vaucher was the first person to put forward a genuine explanation in 1803. He showed that seiches occur when there are brusque changes in atmospheric pressure. These pressure differences generate winds that push the water of the Lake from one place to another. The water level rises where pressure is lowest and conversely drops where it is highest. When the wind dies down, a slow decreasing rocking movement restores the water to its normal equilibrium. Half a century later, the scientist François-Alphonse Forel demonstrated the existence of two types of seiche on Lake Geneva: longitudinal waves oscillating between Villeneuve and Geneva and transverse waves between Morges and the Haute-Savoie shore. It would subsequently be discovered that there are also underwater (internal) seiches in the Lake. They are also caused by winds and affect the thermocline (the transition layer between the warmer surface water and the colder deeper water). When winds are strong in summer, the thermocline fluctuates and produces currents at medium depth.

1. Readings re-transcribed by François-Alphonse Forel for the study, and a subsequent general clarification of different seiche phenomena, at Morges and Veytaux in 1873 and 1874 and at Morges in 1877. The up-and-down oscillations of the limnograph float in the water are mechanically converted into horizontal lines on a roll of paper controlled by clockwork.
2. Vevey limnometer, author unknown, second half of the 19th century, reproduction of a print. In the late 19th century a number of measuring devices, or limnometers, had been placed round the Lake to register rise and fall in levels. The Vevey device, built in 1846, comprised a marble column over a well with a connection to the Lake. The measurement of the magnitudes of displacement of its float meant that the variations in water levels could be studied.
3. Portable limnograph, manufacturer J. Cauderay, 1878, Lausanne. In 1878, the scientist François-Alphonse Forel had this portable limnograph made so that he could take it on his travels, and could thus measure water level variations at different points on the Lake.
4. Effect of wind on the appearance of seiches on Lake Geneva, studio KO, 2018, after Perceval Barrier's illustrations. When the wind blows towards Geneva, it pushes the water in that direction and raises it a few centimetres. When the wind drops, the level of the Lake at Geneva falls, giving rise to a rocking movement that gradually dies away.

1



LE LÉMAN PEUT-IL DÉBORDER ?

Le niveau du Léman a toujours varié depuis sa formation définitive, d'abord naturellement, puis en raison des actions humaines. Mais depuis 1884, son niveau est régulé au centimètre près. Il ne peut donc pas déborder.

Pour comprendre la régulation actuelle du lac, il faut remonter au 16^e siècle. A cette époque, Genève entreprend la construction d'infrastructures de retenues d'eau sur le Rhône. Objectifs ? Alimenter les fontaines de la ville, actionner les moulins, canaliser les poissons vers des nasses, mais également assurer la navigation dans la tôle toute l'année car certains bateaux ne parviennent pas au port en hiver en raison des basses eaux.

En limitant l'écoulement naturel des eaux, ces nouvelles constructions provoquent des hausses périodiques du niveau du lac et des inondations. Le canton de Vaud est le plus touché. Les plaines s'accumulent. Genève fait la sourde oreille pendant plus de 150 ans. Les terribles crues de 1876/77 repoussent le conflit et déclenchent le « Procès du Léman ». Il débouche en 1884 sur un acte intercantonal (Genève, Vaud et Valais) qui impose aux Genevois de maintenir un niveau d'eau dans des limites compatibles avec les différents usages.

2

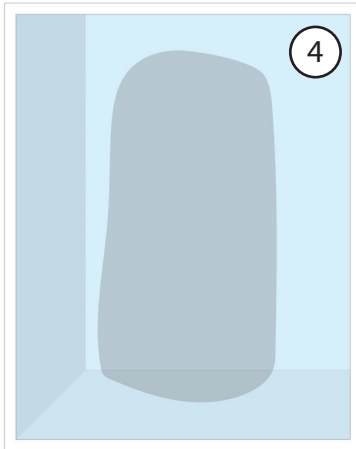


NON, CAR SON NIVEAU EST CONTRÔLÉ AU CENTIMÈTRE PRÈS

3



4



Can Lake Geneva overflow?

The level of the Lake has always varied ever since its final formation, initially naturally and then as a result of human activities. Since 1884, however, the level has been regulated to the nearest centimetre, so that it cannot overflow. In order to understand how the Lake is currently regulated, we have to go back to the 16th century. At the time, Geneva was in the process of undertaking the construction of water storage infrastructures on the Rhone. What were they for? To supply the town's fountains, operate mills and channel fish into traps, but also to ensure the movement of boats in the harbour area throughout the year as some boats were unable to dock in winter because of the low water level. By restricting the natural course of the water, the new constructions led to periodic increases in the level of the Lake and to floods. The canton of Vaud was the most affected. Complaints built up. Geneva turned a deaf ear for over 150 years. The terrible floods of 1876-1877 revived the conflict and unleashed the Procès du Léman (the Lake Geneva Trial). In 1884 it led to an inter-cantonal act (Geneva, Vaud and Valais) requiring Geneva to maintain the water level within limits compatible with the different uses of the Lake.

1.

View of Geneva from the quai des Bergues, author unknown, 18th century, Geneva Library collection (Centre d'icnographie genevoise). This water colour shows the extension of the fortifications into the Lake to protect Geneva from an attack from the water. There was an arsenal on the present-day Ile Rousseau, formerly "Boat Island". Other interesting features are apparent in the picture, including mills, a laundry boat and zig-zag barriers for steering fish to the fish-traps. The main water storage infrastructures, which caused flooding all around the Lake, are not, however, visible since they were located further down river.

2.

Documents filed in 1881 by the State of Vaud against the State of Geneva in the Procès du Léman, Federal Court.

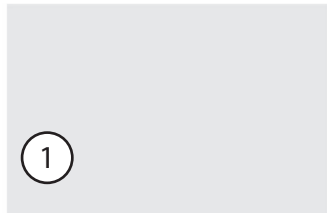
3.

Photograph album detailing the construction of the La Coulouvrenière hydro power plant in Geneva between 1883 and 1886, authors unknown and Ch. Richard. The branch of the Rhone was drained in two stages so that the power plant building (Bâtiment des forces motrices) and hydraulic system could be built.

4.

Pillar indicating the highest water level in Nyon in 1817. In 1816 and 1817 Lake Geneva experienced extraordinarily severe flooding. It is estimated that the water rose 2.80 to 3 metres above its average level. There were floods all around the Lake. At Nyon, a stone plaque was set up in front of the customs building to record the ultimate highwater level in 1817. It was rediscovered in 1899 when the customs building was demolished.

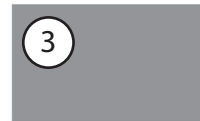
COMBIEN DE TEMPS MET UNE GOUTTE D'EAU POUR TRAVERSER LE LAC ?



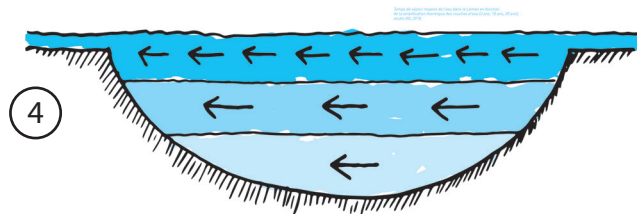
© 1911, La Vie Parisienne, Markous, 1911, photo: Archives de la Ville de Paris.



© 1977, Bulletin technique de la Suisse romande, EPFL hydraulics laboratory, 1977, photo: Archives de la Ville de Paris.



© 2018, studio KO, 2018, photo: Archives de la Ville de Paris.



Depuis son entrée dans le lac, une goutte d'eau devra théoriquement et en moyenne patienter 11,3 ans pour arriver à Genève! Mais comment obtenir un tel chiffre ?

Tout simplement en calculant le temps que mettrait le Léman pour se vider complètement si l'on empêchait toute nouvelle entrée d'eau.

Mais ce résultat n'est qu'une estimation théorique. Un lac n'est pas un simple volume d'eau uniforme. Les différentes couches de masses d'eau et les courants impliquent des variations, dans le temps et dans l'espace: plus chaude et moins dense, l'eau de surface s'écoule plus rapidement que les eaux plus froides et plus denses des profondeurs.

Les eaux du Léman se structurent en trois couches. Pour chacune, les temps de séjour moyens varient: 2 ans jusqu'à 50 mètres de profondeur, 10 ans entre 50 et 250 mètres et 20 ans pour les eaux les plus profondes, jusqu'à 309 mètres.

Calculer les temps de séjour des eaux dans le lac permet notamment de comprendre la capacité de celui-ci à se débarrasser d'une partie des polluants qu'il contient. En moyenne, seulement un douzième des eaux du Léman se renouvelle chaque année.

How long does a drop of water take to cross the Lake?

After entering the Lake, a drop of water in theory needs an average of 11.3 long years before it reaches Geneva! But where does this figure come from? The answer is by quite simply working out how long Lake Geneva would take to empty completely if no more water was allowed to enter it.

But this is only in theory, since a lake is not a simple uniform body of water. The various layers comprising masses of water and currents are subject to variations in time and space; the warmer and less dense surface water flows more rapidly than the colder and denser water deep down.

Three water layers exist in Lake Geneva. The average time of their existence varies in each case: 2 years up to a depth of 50 metres, 10 years for a depth of between 50 and 250 metres and 20 years for the deepest water, up to 309 metres.

Calculating the time water stays in the Lake enables us to understand its capacity for ridding itself of some of its pollutants.

On average, only a twelfth of the water of Lake Geneva is renewed every year.

1. Le roman d'une goutte d'eau, Markous, 1911, illustration from the magazine "La Vie Parisienne".
2. Les courants dans le Léman, Bulletin technique de la Suisse romande, 15 September 1977. In the 1970s, the EPFL hydraulics laboratory undertook a number of studies and measurements in order to understand the currents produced by the wind during the cold season in Lake Geneva.
3. "Meteolakes" online platform, Theo Baracchini, 2016, Ecole polytechnique fédérale de Lausanne (EPFL). Meteolakes supplies, in real time and several days in advance, various physical parameters of Lake Geneva (e.g. temperatures, currents, etc.). The animation shows gyre dynamics during the week of 2 November 2015. Gyres (circular patterns of currents) are often observed on the Lake, principally on the surface. They are a determining factor in defining how long the upper layers of water take to pass through the Lake.
4. Average time water stays in Lake Geneva in terms of the thermal stratification of the water layers (2 years, 10 years, 20 years), studio KO, 2018.

1



PEUT-ON BOIRE L'EAU DU LAC ?

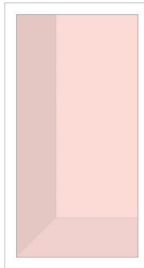
Aujourd'hui, 900'000 personnes environ boivent de l'eau du Léman. Les onze stations de pompage installées autour du lac y puisent chaque année environ 80 millions de mètres cubes d'eau. Mais, pour qu'elle soit potable, l'eau du lac doit être traitée car elle contient notamment des germes, des particules en suspension ou d'autres substances dissoutes « indésirables ».

Par le passé, les riverains ont souvent méprisé l'eau du lac. À Lausanne en 1881, certains la comparaient à du « jus de cabottes », tandis qu'à Evian en 1890, elle « jouit de la plus triste réputation ». Il est vrai que l'eau du Léman n'était pas toujours très propre, en raison notamment des épaves qui s'y déversaient.

Les riverains se sont généralement tournés vers d'autres réservoirs naturels, comme les sources qui sont nombreuses dans la région. À époque romaine, un aqueduc d'environ 10 kilomètres amenait à Nyon, pourtant au bord du lac, de l'eau provenant de Divonne.

Néanmoins, depuis le début de l'occupation des rives, il y a 15'000 ans, d'innombrables riverains se sont désaltérés dans le Léman. Par exemple, la ville de Genève a construit dès 1715 des machines capables de pomper l'eau du lac pour alimenter ses fontaines. L'eau était alors filtrée grâce à une couche de gravier et des bâches en toile de sac, permettant de retenir les saletés.

2



Le lac est un réservoir d'eau potable (the Lake is a reservoir of drinking water), Exem, 1989.



OUI, MAIS SEULEMENT APRÈS QU'ELLE AIT ÉTÉ TRAITÉE

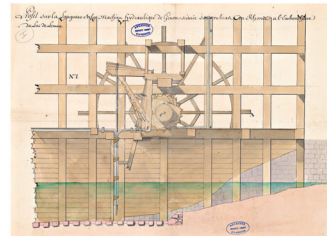
Source: www.association-pour-la-sauvegarde-du-leman.ch

3



Plaque from a ship of the Compagnie Générale de Navigation (General Shipping Company) (CGN), 20th century.

4



Longitudinal section of the Geneva water extraction machine situated on a branch of the Rhone at the mouth of Lake Geneva, Jean Tronchin, around 1755, Archives communales d'Avignon collection. It was built by Jean Maritz in 1727, and with a wheel 7 metres in diameter could extract 300 litres of water per minute.

5

Is the Lake water drinkable?

Today some 900 000 people drink Lake Geneva water. The eleven pumping stations round the Lake extract around 80 million cubic metres of water every year. To make it drinkable, however, it needs to be treated since it contains germs from particles in suspension and other “undesirable” substances dissolved in the water. In the past, people living along the Lake often despised its water. In Lausanne in 1881 some people compared it to “corpse juice”, while in Evian in 1890 it “had the poorest of reputations”. It is a fact that the water of Lake Geneva was not always very clean, mostly because of the sewers that drained into it. People who lived along the Lake generally looked to other natural sources of water, such as the numerous springs in the region. In Roman times, an aqueduct about 10 kilometres long carried water from Divonne to Nyon, even though the latter town stood on the waterfront. Since the earliest occupation of its shores 15 000 years ago, however, innumerable locals have slaked their thirst in Lake Geneva. For example, in 1715 Geneva built machines for pumping water from the Lake to supply its fountains. The water was filtered through a layer of gravel and jute fibre canvas which kept back the dirt and rubbish.

1.

Le lac est un réservoir d'eau potable (the Lake is a reservoir of drinking water), Exem, 1989. In 1989, the Association pour la Sauvegarde du Léman (Association for safeguarding Lake Geneva) launched a vast awareness campaign entitled “Water is life”, in order to capture the attention of the public at large with regard to problems relating to the pollution of the Lake.

2. Bottle for extracting fresh water, late 19th century, used to obtain water that was both clean and fresh. The piece of cork wedged in the neck prevented the bottle from filling from the surface. Deeper down, with the pressure being stronger, the cork was forced down into the bottle which then filled with water that was fresher and cleaner.

3.

Plaque from a ship of the Compagnie Générale de Navigation (General Shipping Company) (CGN), 20th century.

4.

A humorous drawing in the “Journal des Bains”, published by the Association d'usagers des Bains des Pâquis (Association of users of the Pâquis Baths), Herrmann, summer 2015. In order to illustrate an article on the water-tasters of Geneva's public utility services, the press artist Herrmann imagines an improbable scene mingling torture and tasting.

5.

Longitudinal section of the Geneva water extraction machine situated on a branch of the Rhone at the mouth of Lake Geneva, Jean Tronchin, around 1755, Archives communales d'Avignon collection. It was built by Jean Maritz in 1727, and with a wheel 7 metres in diameter could extract 300 litres of water per minute.

LE LAC EST-IL TROP SALE ?

1

Le Léman a pu être nettoyé des substances qui ont fait le tuer entre les années 1960 et les années 1980. Ce succès a été rendu possible grâce à la construction de nombreuses stations d'épuration, à l'évolution de la législation, et aux actions de sensibilisation. Mais de nouvelles menaces sont apparues depuis: les micropolluants et les microplastiques.



Provenant des eaux usées et des eaux de ruissellement, les micropolluants se retrouvent dans l'eau du lac ou s'accumulent dans ses sédiments. Il s'agit d'herbicides, d'insecticides, de résidus médicamenteux, ou encore d'éléments-traces métalliques (mercure, plomb, chrome, etc.).

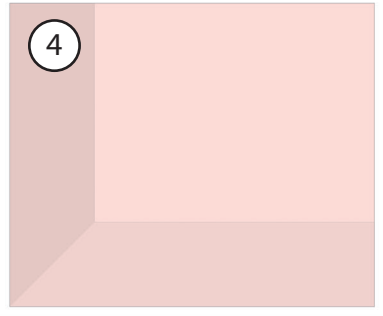
Les effets de ces substances sur les organismes, et donc sur l'écosystème lacustre, restent mal connus. Les risques dépendent de leur concentration dans l'eau, mais aussi de leur diversité, car la combinaison de plusieurs sortes de micropolluants est susceptible de renforcer leur toxicité.

Le lac et ses plages doivent également faire face à la présence de plastiques de tailles variées. Ils proviennent de la fragmentation de déchets, mais aussi de matériaux utilisés dans la construction, l'agriculture, les industries, etc.



Montserrat Filella & Andrew Turner, 2018, a photograph taken as part of a scientific study of the impact of the plastics in Lake Geneva. Some of these particularly dangerous plastics have not been in use for several years now, but it takes so long to break them down (several centuries) that they are still contributing to the pollution of the Lake. Straws, although they only account for a tiny fraction of the plastic polluting the Lake, are particularly harmful. Because of their size, they are consumed by some of the aquatic fauna, especially the fish.

3



Is the Lake too dirty?

The substances which nearly killed off Lake Geneva between the 1960s and the 1980s have little by little been cleaned up. This result owes its success to the construction of numerous sewage plants, the evolution of legislation and awareness activities. Since then, however, new threats have emerged: micropollutants and microplastics. Micropollutants from waste water and runoff are found in the lake water or accumulate in the sediments. They include herbicides, insecticides, residues of medicinal products or metal trace elements (mercury, lead, chrome, etc.). The effects of these substance on lake organisms and therefore on the Lake Geneva ecosystem are poorly known. The risks depend both on their concentration in the water and on their diversity, since the combination of several kinds of micropollutants may well increase their toxicity. The Lake and its beaches also have to deal with the presence of plastics of varying size resulting from the breakdown of rubbish but also from the materials used in construction, agriculture, industry, etc.

1. Collection of products used in daily life (cosmetics, medicines, detergents, etc.). Most of the products we use every day contain synthetic substances that end up in the drains before reaching a sewage plant (STEP). While the micro-organisms present in the STEP break down natural pollutants very efficiently, they find it difficult to cope with synthetic substances. Many of these therefore end up in the Lake with harmful effects on aquatic plants and animals.
2. 60 vaches dans le Léman (60 cows in Lake Geneva), Luc Frieden, 2018. Scientists calculate that Lake Geneva contains something like 60 tonnes of micropollutants. The artist has symbolised this amount by creating a "poya", with 60 cows going down into the Lake. A "poya" is a type of popular art depicting the seasonal migration of cattle to the mountain pastures.
3. Plastic rubbish piled up on the Maladaire beach (Vaud), Montserrat Filella & Andrew Turner, 2018, a photograph taken as part of a scientific study of the impact of the plastics in Lake Geneva. Some of these particularly dangerous plastics have not been in use for several years now, but it takes so long to break them down (several centuries) that they are still contributing to the pollution of the Lake. Straws, although they only account for a tiny fraction of the plastic polluting the Lake, are particularly harmful. Because of their size, they are consumed by some of the aquatic fauna, especially the fish.
4. Nest of a coot (*Fulica atra*) found on the shores of Lake Geneva. For coots, like many other species, even the potentially toxic rubbish found in nature has its uses. Unfortunately, a nest built from plastics is far more easily flooded in heavy rain.

1

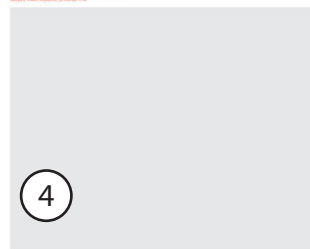
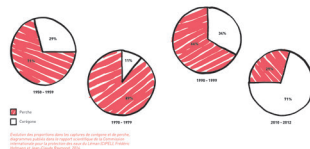


2



LE LAC EST-IL TROP PROPRE ?

3



4

Entre les années 1960 et les années 1980, le Léman était tellement pollué que l'on pensait que son écosystème allait mourir. Son principal problème était l'eutrophication, c'est-à-dire l'apport excessif de nutriments dans l'eau. Le phosphore en particulier qui augmente principalement la production d'algues. Pour décomposer et mineraliser ces algues, le lac doit utiliser tellement d'oxygène qu'il finit par s'asphyxier et met en péril la survie des espèces présentes, en particulier les poissons.

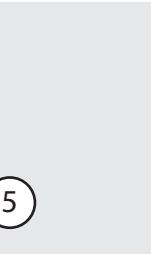
Mais grâce à d'importants investissements (construction de stations d'épuration) et à des modifications de la législation (interdiction des phosphates dans les lessives), le lac a petit-à-petit retrouvé un bon état de santé. La Commission Internationale pour la Protection des Eaux du Léman (CIPEL), qui surveille le lac depuis 1963, considère qu'il est aujourd'hui convalescent.

Ce nouvel état du Léman ne fait pas l'affaire de tous. Pour certains pêcheurs, le lac est trop propre, car les perches le posent le plus demandé du lac sont plus nombreuses dans les eaux riches en nutriments et donc, en phytoplancton et en zooplancton. Depuis la fin des années 1990, les quantités de perches pêchées ont fortement baissé.

A l'inverse, les pêcheurs attrapent aujourd'hui de plus grandes quantités de coregones, car ces poissons préfèrent les eaux mésotrophes (modérément riches en nutriments).

Mais l'évolution des communautés de poissons n'est certainement pas liée uniquement à la concentration en phosphore. D'autres facteurs, comme les micropolluants ou le réchauffement climatique, sont probablement sous-estimés.

5



Is the Lake too clean?

Lake Geneva was so polluted between the 1960s and the 1980s that it was believed that its ecosystem would be killed off. Its main problem was eutrophication, i.e. excessive enrichment of the water with nutrients (especially phosphorus) the main result of which is the growth of algae. In order to decompose and mineralise the algae the Lake needs to use so much oxygen that it finally asphyxiates and endangers the survival of existing species, particularly fish. However, as a result of large-scale investments (construction of sewage plants) and changes in legislation (a ban on phosphates in detergents), it has little by little recovered its health. The International Commission for the Protection of Lake Geneva (CIPEL), which has been monitoring the Lake since 1963, considers that it is in a state of convalescence. This new situation does not satisfy everyone. For some fishermen, the Lake is too clean, because the perch (the fish for which there is most demand) tends to congregate in nutrient-rich water, i.e. rich in phytoplankton and zooplankton. Since the late 1990s, the quantities of perch fished have considerably decreased. Conversely, fishermen today are catching larger numbers of whitefish since these prefer mesotrophic water (moderately rich in nutrients). The evolution of fish communities is certainly not linked only to the concentration of phosphorus. Other factors, such as micropollutants or global warming are probably underestimated.

1. Cupra, Samuel Henchoz, 1946, Museum für Gestaltung (Zurich) collection.
2. Rebendünger Lonza, D. Müller, 1935, Museum für Gestaltung (Zurich) collection. The fungicide (substance for eliminating fungi) Cupra and the fertilizer commercialised by Lonza are two chemical products used abundantly in the vineyards. They have contributed to soil pollution but also to the pollution of the Lake as a result of runoff and the pollution of the groundwater.
3. Evolution of the proportion of whitefish and perch in catches, a diagram published in the scientific report of the International Commission for the Protection of Lake Geneva (CIPEL), Frédéric Hofmann and Jean-Claude Raymond, 2014.
4. Shot of a mass of perch in the trap of a Savoyard fisherman, Robert Huysecom, spring 1994.
5. Headline of the daily "Le Matin" of 14 July 2016.

A QUI APPARTIENT L'EAU DU LÉMAN ?

1

Le Léman est un lac international. 59.5% de sa surface appartient à la Suisse, 40.5% à la France. Faut-il en déduire que la Suisse possède 59.5% des 89 milliards de m³ d'eau que contient le lac ?

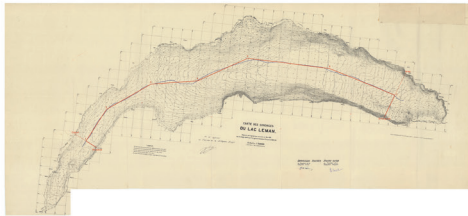
La réponse n'est pas aussi simple, car selon les lois françaises et suisses, l'eau est considérée comme un « bien commun », c'est-à-dire n'appartient à personne et pouvant être utilisée par tous. La France et les cantons de Genève, de Vaud et du Valais étant propriétaires des berges et des fonds du lac, c'est à eux de réguler l'usage de l'eau qui s'y trouve.

L'Etat français et les trois cantons contrôlent l'utilisation de l'eau du lac au sein de leur territoire, en accordant par exemple des concessions à des communes ou des entreprises. Mais, ils agissent de façon isolée. Alors que la France et la Suisse ont signé des accords sur la délimitation de la frontière, la pêche, la navigation et la lutte contre la pollution, l'utilisation de l'eau ne fait pas l'objet d'une coordination.

Actuellement, sur les 11 stations de pompage qui prélèvent de l'eau dans le lac, 9 sont du côté suisse.

Source: Atlas de la Suisse romande, 1988, p. 100. Les données de surface du lac sont issues de la carte de l'Etat de la Suisse romande, 1988, p. 100. Les données de volume d'eau sont issues de la carte de l'Etat de la Suisse romande, 1988, p. 100.

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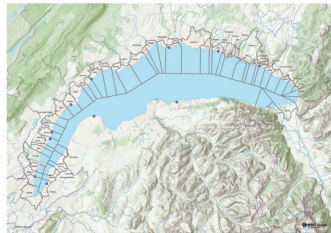


Source: Atlas de la Suisse romande, 1988, p. 100. La carte est une reproduction de la carte de l'Etat de la Suisse romande, 1798, p. 100.



Source: Atlas de la Suisse romande, 1988, p. 100. La photo est une reproduction de la photo de l'Etat de la Suisse romande, 1988, p. 100.

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Source: Atlas de la Suisse romande, 1988, p. 100. La carte est une reproduction de la carte de l'Etat de la Suisse romande, 1988, p. 100.

4

Who does the water of the Lake belong to?

Lake Geneva is an international lake; 59.5% of its surface belongs to Switzerland, 40.5% to France. Does that mean that Switzerland owns 59.5% of the 89 billion m³ of water in the Lake? The answer is not as simple as that since in French and Swiss law water is considered to be a “common good”, i.e. that belongs to no one and can be used by everyone. Since France and the cantons of Geneva, Vaud and Valais own the shores and the Lake floor, it is up to them to regulate the use of the water it contains.

Although the French State and the three cantons control the use of the water within their own territories, for example, by granting concessions to communities or firms, they act in isolation. While France and Switzerland have signed agreements on the delimitation of the border between them, as well as on fishing, shipping and the fight against pollution, the use of the lake water has not been coordinated. At this time, of the 11 pumping stations that extract water from the Lake, 9 are on the Swiss side.

1. Map of Vaud under Bernese occupation, Franz von Reilly, before 1798. In 1564, the Duke of Savoy and the City and Republic of Bern signed the Treaty of Lausanne, establishing the principle of a border through the middle of the Lake. This map, drawn 200 years later, shows the Lake divided between Vaud under Bernese occupation (it would obtain independence in 1798), Savoy (which would be annexed to France in 1860), the Kingdom of France (which gifted Versoix to the canton of Geneva in 1815) and Geneva which at that time was independent.
2. Map annexed to the Convention between Switzerland and France on the determination of the border in Lake Geneva, 1953, reproduction, Swiss Federal Archives. For an accurate determination of the border through Lake Geneva, the Federal Council and the President of the French Republic each appointed an expert, who proposed the line of the border drawn on this map in red. The Convention was signed at Geneva on 25 February 1953.
3. The Emosson Dam, Michel Darbellay, 28 October 1993, Médiathèque Valais-Martigny collection. In order to enable the building of the Emosson Dam (brought into service in 1975), Switzerland and France signed a convention in 1963 providing for an exchange of territory between the two countries. It also provides for the diversion of French water to the dam, and for Switzerland to return this water to France via the Rhone. Before this happens, the water is stored in Lake Geneva. Its volume represents 87 million m³ annually, or a 15-centimetre slice of the entire surface of the Lake.
4. Map showing the 11 stations that pump water from the Lake, ESRI, 2018. The extraction of drinking water is effected by means of a pipe located between 40 and 50 metres under the surface. Although there is no communal ownership of the Lake, the cadastral map invents fictitious territories for each of the Swiss communities.

UN POISSON DU LÉMAN PEUT-IL REJOINDRE PARIS OU STRASBOURG ?

Le Léman n'étant pas connecté aux bassins de la Seine et du Rhin, un poisson lémanique ne peut pas se retrouver à Paris ou à Strasbourg. Mais il aurait pu en être autrement.

Au 17^e siècle, les voies navigables d'Europe constituent un réseau de transport souvent plus fiable que les routes. En 1636, Elie Gouret, Huguenot fraîchement arrivé à Genève, imagine construire un canal entre le Léman et le lac de Neuchâtel, pour relier le Rhin au Rhône. Après avoir convaincu investisseurs et décideurs, il entreprend des travaux sur la Thièle entre Yverdon et Cossonay. Mais en 1645, alors qu'il faut encore construire une quarantaine d'écluses sur la Venoge pour amener les embarcations de Cossonay à Morges, des éboulements et pluies torrentielles mettent définitivement fin au projet.

Au 19^e siècle, pour l'ingénieur parisien Paul Duvillard, le Léman représente un formidable réservoir d'eau douce. Il envisage de détourner les eaux du lac pour approvisionner Paris, qui connaît des problèmes d'alimentation en eau potable. Depuis Chens-sur-Léman, il prévoit de construire un canal de 507 kilomètres qui irait se déverser dans la Seine. Mais ce projet ne fait pas l'unanimité. Du côté suisse, les Genevois redoutent une baisse d'alimentation des machines hydrauliques. En France, la salubrité du Léman est remise en doute. Mais la plus vive résistance vient des usagers du Rhône en aval du lac qui redoutent une modification du débit du fleuve, déjà mis à mal par les usines électriques. Le projet sera finalement abandonné en 1913.

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NON, LE LÉMAN N'EST PAS CONNECTÉ AUX BASSINS DE LA SEINE ET DU RHIN

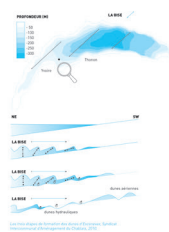
Can a fish from Lake Geneva turn up in Paris or Strasbourg?

Since Lake Geneva has no connections to the basins of the Seine and the Rhine, it is not possible for a fish from Lake Geneva to get to Paris or Strasbourg. But things might have been different once upon a time. In the 17th century, Europe's waterways constituted a transport network that was often more reliable than its roads. In 1626, Elie Gouret, a Huguenot newly arrived in Geneva, imagined building a canal between Lake Geneva and Lake Neuchâtel, in order to link the Rhine to the Rhone. After persuading investors and deciders, he began work on the Thièle between Yverdon and Cossonay, but in 1645, when he still needed to construct about forty locks on the Venoge to enable boats to travel from Cossonay to Morges, landslides and torrential rain put a final stop to the project. In the 19th century, Lake Geneva was an extraordinary freshwater reservoir in the eyes of the Paris engineer Paul Duvillard. He envisaged diverting the water of the Lake to furnish Paris which had drinking water supply problems. His idea was to build a canal 507 kilometres long which would flow into the Seine. The project did not, however, meet with universal approval. On the Swiss side, the inhabitants of Geneva feared a decreased supply of water for their hydraulic machinery. In France, there were doubts as to how salubrious Lake Geneva actually was. But the greatest resistance was from the users of the Rhone down-river from the Lake, who feared that the flow, already negatively affected by the power stations, would be modified. The project was finally abandoned in 1913.

1. Company for the study of the conveyance of French water from Lake Geneva, Registered beneficiary share, 1894. Paul Duvillard, who designed the project, was both the issuer and the beneficiary of this security.
2. Overall plan of the project for the conveyance of French water from Lake Geneva, Paul Duvillard, 1900. The plan shows three layouts studied by Paul Duvillard. The red line indicates layout he intended to use.
3. Stamp created by Fretz Frères SA, 1917.
4. Association Suisse pour la navigation du Rhône au Rhin, Prospectus for the promotion of the association, 1995-1999. More than three centuries after the first project was abandoned in 1645, the canal between Lake Geneva and Lake Neuchâtel continues to inspire visions. If it materialised, it would link the Rhone to the Rhine and in this way connect the Mediterranean to the North Sea.
5. Association Suisse pour la navigation du Rhône au Rhin, Canal d'Enteroches between Lake Geneva and lake Neuchâtel, 1953. This plan shows that the difference in altitude between Lake Geneva and Lake Neuchâtel is a major obstacle to the project of a canal between the two lakes.

LE LAC A-T-IL DES PLAGES DE SABLE ?

1



Le lac dispose de 121 plages publiques, dont 18 de sable. Parmi celles-ci, la plage d'Excenevex en Haute-Savoie est la seule dont l'ensablement est naturel.

La formation et la consolidation de la plage d'Excenevex se déroulent en trois phases. D'abord, des sables sont amenés dans la baie par deux rivières le Vion et la Foron et l'érosion des falaises d'Excenevex. Ensuite, la houle et le vent forment des dunes de sable sous l'eau. Enfin, lorsque le niveau du lac baisse, le vent transporte vers la rive les sables qui émergent.

Ce phénomène, très rare au bord d'un lac, ne se retrouve en Europe qu'au bord du lac Balaton en Hongrie.

Les autres plages de sable du Léman sont toutes artificielles. Pour la création de la plage de Lausanne-Ouchy en 1927, environ 3 000 tonnes de sable ont été utilisées. En 2016, il a fallu 679 tonnes de sable pour remettre en état la plage de Prévèrenge.

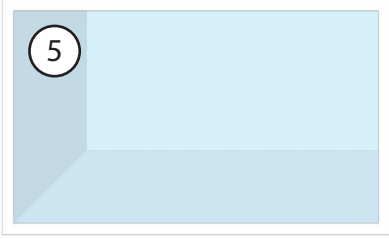


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Does the Lake have sand beaches?

The Lake has 121 public beaches, 18 of which are sand beaches. Of these, only the beach at Excenevex in Haute-Savoie is naturally sandy. The formation and consolidation of this beach took place in three phases. First of all, two rivers (the Vion and the Foron) brought sand into the bay, while sand also came from the erosion of the cliffs at Excenevex.

Subsequently, the swell and the wind formed sand dunes under the water. Lastly, when the level of the Lake fell, the wind carried the emerging sand to the shore.

The only other occurrence in Europe of this phenomenon, very rarely found along a lake, is on the shores of Lake Balaton in Hungary. The other sand beaches on Lake Geneva are all artificial. Some 3 000 tonnes of sand were used to build the Lausanne-Ouchy beach in 1927, while in 2016, 679 tonnes of sand were needed to re-create the beach at Prévèrenge.

1. The three stages in the forming of the Excenevex dunes, Syndicat Intercommunal d'Aménagement du Chablais, 2010.
2. Sand bank which emerges during low water on the beach at Excenevex, Syndicat Intercommunal d'Aménagement du Chablais, 2010.
3. Prospectus for Lausanne-Ouchy beach, Uvachrom, ca. 1930. The beach pictured was 260 metres long with a width varying between 7 and 18 metres. It was protected from erosion by a 78-metre long dyke. Lausanne-Ouchy beach was opened in 1927 and closed in 1939.
4. Map of the Lake Geneva beaches, International Commission for the Protection of Lake Geneva (CIPEL), 2018. CIPEL monitors the water quality of 113 beaches around the Lake.
5. Samples of material from various Lake Geneva beaches. All were extracted from the deep water and the shores of the Lake.

LES RIVES DU LAC SONT-ELLES NATURELLES ?



Sur les 200 kilomètres de rives que compte le Léman, 26% sont encore naturelles. Il s'agit de forêts, de grèves ou encore de roselières.

Sur les 74% de rives restantes, 13% sont semi-naturelles (champs, cultures, bandes herbeuses, ...) et 61% totalement artificielles. Celles-ci sont constituées de murs ou d'énichements et occupées par des bâtiments, des routes ou des quais.

En plus d'avoir été murées ou enrochées, de nombreuses rives du lac ont été élargies. A Nyon, le quai des Alpes a été construit sur le lac entre 1894 et 1910. A Lausanne, pour l'organisation de l'Exposition nationale de 1964, les rives ont été agrandies de 102 000 m², soit l'équivalent de 20 terrains de football.

Les rives naturelles sont essentielles au bon fonctionnement écologique du lac. Elles permettent notamment le développement de végétaux qui améliorent la qualité des eaux et permettent à de nombreuses espèces de se nourrir, de s'abriter ou de se reproduire. C'est pourquoi, la préservation des rives naturelles et la renaturation des rives artificielles comptent parmi les principaux objectifs de la Commission internationale pour la protection des eaux du Léman (CIPEL).

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Plan de l'ancien quartier de la Rive à Nyon, Suisse romande, vers 1873. On voit les maisons et le quai des Alpes qui a été construit sur le lac entre 1894 et 1910.



4



5

Are the shores of the Lake natural?

Of the 200 kilometres of shore round Lake Geneva, 26% are still in a natural state, and take the form of forests, beaches or reedbeds. Of the remaining 74%, 13% are semi-natural (fields, plantations, grassy areas, ...) and 61% are totally artificial, consisting of walls or rockfill and occupied by buildings, roads or embankments. In addition to being blocked off or strengthened with rockfill, many areas of the lakeshore have been widened. In Nyon, the Quai des Alpes was built on the Lake between 1896 and 1910. In Lausanne, the lakeshore was expanded by 140 000m² - the equivalent of 20 football pitches - for the organisation of the National Exhibition of 1964 (Expo 64). The Lake's natural shores are essential to the functioning of its ecosystem. They permit the development of plant life that improves the quality of the water and enables numerous species to feed, shelter and reproduce. For this reason the International Commission for the Protection of Lake Geneva (CIPEL) includes the conservation of the shores in a natural state and the renaturation of the artificial shoreline among its principal objectives.

1. (Evolution of the planning and development of the Lausanne lakeshore between 1873 and 1989, district of Vidy), Annick Lavenex, 2012, document derived from her Master's dissertation "Les rives lausannoises entre ville et paysages". Over the last two centuries, the Lausanne lakeshore has undergone many transformations, in particular the construction of the embankment between Ouchy and the Tour Haldimand, inaugurated in 1901, the creation of Bellerive Plage between 1934 and 1937 and the organisation of the National Exhibition in 1964.
2. Les bains Huber à Nyon (the Huber Baths in Nyon), Jules Gachet, 1907.
3. Chantier de construction du quai des Alpes à Nyon (Quai des Alpes, Nyon, construction site), author unknown, Archives communales de Nyon, 1904-1910, collection. Before the Quai des Alpes was built, the houses in the district of Rive (on the left on leaving the Museum), stood on the waterfront. You can compare this photograph with the painting by Jules Gachet showing the same site a few years earlier (the triangular roof can be taken as a landmark).
4. Regulation concerning discretionary permits on the Lake, Republic and Canton of Geneva, 1917. This regulation establishes the means for obtaining a permit for development projects on the Lake, e.g. harbours, dykes, jetties, rockfill and even ladders. It also specifies the annual fee for each project. An annual fee of 2.50 francs per metre was charged for building a dyke and 3 francs for installing a ladder.
5. Washerwomen on the lakeshore, author unknown, late 19th century. The photograph shows washerwomen and linens being dried on a natural shingle beach.

COMMENT SONT NÉES LES ÎLES DU LÉMAN ?

1

On compte six îles sur le lac, toutes suisses: l'île Rousseau à Genève, l'île de Choisi sur la commune de Bursinel, l'île de la Harpe à Rolle, l'île de Salagnon vers Montreux, l'île de Chillon sur laquelle est construit le célèbre château, et l'île de Peilz au large de Villeneuve.

Plus ou moins artificielles, ces îles ont toutes une base naturelle: des rochers ou des hauts fonds sableux. Elles font partie intégrante du patrimoine du lac et ont chacune une histoire particulière.

Célébre pour son plateau qui semble occuper presque toute sa superficie, l'île de Peilz aurait été construite sur un haut fond sableux au cours du 18^e siècle. Également appelée par le passé «île de Paix» ou «île des deux amants», suite à la noyade d'un jeune Anglais en voyage avec sa fiancée, l'île aurait été offerte par la Suisse à la reine Victoria qui l'aurait rendue après avoir découvert les impôts fonciers qu'on lui réclamait.

Avant de porter le nom de Salagnon, l'île située sur la commune de Montreux y était qu'un îlot appelé «La Roche aux Mouettes». En 1878, l'ingénieur Joseph d'Allinges y fit déverser les matériaux d'excavation des futurs tunnels de Meillerie pour créer une île sur laquelle sera construite une villa de style florentin au début du 20^e siècle. Le nom Salagnon, qui désignait un certain volume de sel, proviendrait de l'époque où des bateaux déposaient du sel sur La Roche aux Mouettes au set de contrebande.

De haut en bas: l'île Rousseau à Genève, l'île de Choisi sur la commune de Bursinel, l'île de la Harpe à Rolle, l'île de Salagnon vers Montreux, l'île de Chillon sur laquelle est construit le célèbre château, et l'île de Peilz au large de Villeneuve.

2



KURSAAL DE GENÈVE - LA SCÈNE AUX BALLETTES DE LA CÔTE

3



ÎLE DE PEILZ VUE DU CIEL (ÎLE DE PEILZ FROM ABOVE), JEAN-MARC FIVAT, 24 JUIN 1999

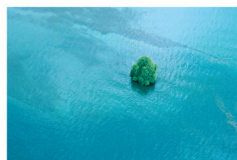


4



ÎLE AUX STERNES DE PRÉVERENGES (TERN ISLAND, PRÉVERENGES), ODILE MEYLAN, PHOTOGRAPH PUBLISHED IN "24 HEURES" ON 10 JULY 2016

5



ÎLE DE PEILZ VUE DU CIEL (ÎLE DE PEILZ FROM ABOVE), JEAN-MARC FIVAT, 24 JUIN 1999

How did the islands in Lake Geneva come into existence?

There are six islands in the Lake, all Swiss: Île Rousseau in Geneva, Île de Choisi in the commune of Bursinel, Île de la Harpe at Rolle, Île de Salagnon near Montreux, Île de Chillon on which the famous castle is built, and Île de Peilz offshore at Villeneuve. Although they are mostly artificial, they all have a natural base of rocks or sand shoals. They are an integral part of the heritage of the Lake and each has its own history. The Île de Peilz, famed for a plane tree which seems to take up nearly all its surface area, was allegedly built on a sand shoal during the 18th century. In the past, it was also known as the Île de Paix (Peace Island) or Île des deux amants (Two lovers' island), after the death by drowning of a young Englishman travelling with his fiancée, and was gifted to Queen Victoria by Switzerland; she apparently handed it back after discovering the land taxes she was required to pay. The island belonging to the town of Montreux was just a reef called La Roche aux Mouettes (Seagull Rock) before it took the name of Salagnon. In 1878, the engineer Joseph d'Allinges dumped the excavation debris of the future Meillerie tunnels on the reef in order to create an island, on which a Florentine style villa would be built in the early 20th century. The name Salagnon, which denotes a specific volume of salt, allegedly derives from the period when boats deposited smuggled salt by night on the Roche aux Mouettes.

1. Île de Salagnon, Charnaux frères & Co, late 19th century. The villa on Salagnon was built at the request of the French painter Théobald Chartran who bought the island in 1900. The following year he settled there until his death in 1907.
2. Île de Salagnon, SADAG, 1913, reproduction of a postcard. In 1913, a show called "Revue-féerie" (Extravaganza) was on at the Kursaal in Geneva, displaying 500 costumes worn by 150 artists, including 80 female ballet dancers. The villa on the Île de Salagnon can be identified in the scenery for the fourth section of Act I, "La Roche aux Mouettes".
3. Villeneuve et l'île, author unknown, a lithograph produced by Engelmann in 1827. If the picture is to be believed, there was a small house and three trees on the Île de Peilz in the early 19th century.
4. Île aux sternes de Préverenges (Tern Island, Préverenges), Odile Meylan, photograph published in "24 Heures" on 10 July 2016. This is the latest of Lake Geneva's islands, and consists of a metal platform constructed at Préverenges in 2015 and intended as a nesting site for the Common Tern (*Sterna hirundo*), a species which seeks out small islands away from land-based predators to raise its chicks.
5. Île de Peilz vue du ciel. (Île de Peilz from above), Jean-Marc Fivat, 24 June 1999. It is said that three plane trees were planted on the island in 1851. There is only one left.



1

Le lac Léman est un lac d'origine glaciaire. Il a été formé par le glacier du Rhône qui a avancé et reculé pendant la dernière période glaciaire. Les plus vieilles pierres du lac sont des blocs erratiques laissés par le glacier du Rhône au moment de son recul. Il y a 18 000 ans, comme les pierres du Niton à Genève, la pierre Amour à Thonon ou la pierre de Coulet à Saint-Prex.

D'OÙ VIENNENT LES PIERRES DU LAC ?



3



Il y a des pierres dans le Léman. Beaucoup proviennent du passé géologique de la région (formation des Alpes, avancées et reculs du glacier du Rhône). Les plus vieilles sont des blocs erratiques laissés par le glacier du Rhône au moment de son recul. Il y a 18 000 ans, comme les pierres du Niton à Genève, la pierre Amour à Thonon ou la pierre de Coulet à Saint-Prex.

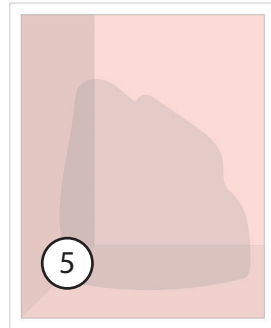
L'eau du Léman est aussi chargée en particules très fines d'argile, de limon et de sable provenant de ses affluents qui transportent des éléments plus grossiers comme le gravier. Chaque année, on extrait des tonnes de ces matériaux du lac pour des aménagements terrestres. Jusqu'au 18^e siècle, on prélevait aussi dans le lac de la molasse, une roche sédimentaire créée lors de la formation des Alpes et qui occupe la majeure partie du Plateau suisse et donc du substrat rocheux du bassin du lac.

Il y a enfin des pierres tout autour du Léman qui témoignent des aménagements réalisés par les riverains : quais, jetées, digues, etc. Aujourd'hui, plus de 60% des rives sont composées de murs et d'enrochements.



Le lac Léman est un lac d'origine glaciaire. Il a été formé par le glacier du Rhône qui a avancé et reculé pendant la dernière période glaciaire. Les plus vieilles pierres du lac sont des blocs erratiques laissés par le glacier du Rhône au moment de son recul. Il y a 18 000 ans, comme les pierres du Niton à Genève, la pierre Amour à Thonon ou la pierre de Coulet à Saint-Prex.

4



5

Where do the Lake's rocks and stones come from?

There are rocks and stones in Lake Geneva. Many of them come from its geological past (the formation of the Alps, the advancing and retreating of the Rhone glacier). The most visible of these are the glacial boulders or erratics left behind by the Rhone glacier when it retreated 18 000 years ago; they include the Pierres du Niton in Geneva, the Amour rock at Thonon or the Coulet rock at Saint-Prex. The water of Lake Geneva also contains very fine particles of clay, silt and sand derived from its tributaries which transport coarser materials like gravel. Every year, tonnes of these materials are extracted from the Lake for development work on land. Up until the 18th century, molasse, a sedimentary rock created when the Alps formed was also extracted from the Lake. Most of the Swiss Plateau is molasse as is the rocky substrate of Lake Geneva's basin, There are also rocks and stones all around Lake Geneva attesting to the developments made by the local population in the form of embankments, jetties, dykes, etc. More than 60% of the lakeshore today is composed of walls and rockfill.

1. The dredge located offshore from the Grangettes nature reserve, Matthieu Gafsou, 2014. Since 1910, the Sagrave company has been dredging the bottom of the Lake for materials such as sand and gravel, with the obligation since the late 1990s of filling in old extraction pits. The dredge offshore from the Grangettes nature reserve has given rise to numerous criticisms, since the reserve is an internationally important wetland site recognised in the Ramsar Convention.
2. Underwater quarry for the mining of molasse at Pregny-Chambésy, in operation up to 1700, Service du cadastre (land register), Geneva, 1963, photograph reproduced with the permission of the SITG. The molasse was extracted during the winter when the level of the Lake was low. The area to be mined was isolated by means of cofferdams, then pumped dry. The workmen could then cut out the blocks of molasse from the Lake bottom. Many buildings in the region are partially constructed from molasse, including the cathedrals of both Geneva and Lausanne.
3. Pierre du Niton, Leo Wehrlé, 1930, ETH-Bibliothek collection, Zurich. The Pierres du Niton (only one can be seen on the photograph), are glacial boulders situated in the harbour area (rade) of Geneva. In 1820, the engineer Guillaume-Henri Dufour used one of the two rocks to determine the average level of the Lake. He went on to use it as a reference point for a map of Switzerland on a scale of 1:100000. The rock is still used as a height reference in Switzerland.
4. Unloading Meillerie stone in the Eaux-Vives commercial port in Geneva, author unknown, around 1905. A lateen-rigged vessel made an annual average of 80 trips between Meillerie and Geneva. On each trip, it carried between 75 and 100 m³ of stone. On arrival, six people were needed to unload 80 m³ of stone in 5 hours.
5. Pierre de Meillerie (Meillerie stone). Between the second half of the 18th century and the start of the 20th, the Meillerie quarries on the French side of the Lake supplied the entire region with stone. In 1903, 117 000 tonnes of this stone were unloaded at Geneva. Meillerie stone was used for many buildings, including the Grand-Pont in Lausanne and Cornavin Station in Geneva.

QUI FABRIQUE LES PERLES DU LÉMAN ?

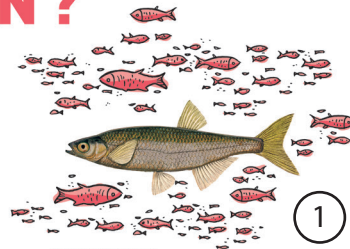
Dans les années 1920, une entreprise de fabrication et de vente de perles du lac se développe à Saint-Gingolph. Selon la Gazette de Lausanne en 1925, elles sont « fort appréciées des cinéastes et actrices en tous genres, pourvu une soixantaine d'ouvrières en fabriquent au mètre courant ».

Pour fabriquer des perles du lac, on fixe des noyaux en émail ou en porcelaine sur de fines tiges de cuivre. On les trempe ensuite, entre cinq et vingt-cinq fois selon la qualité désirée, dans de l'essence d'Orient, une substance produite à partir d'écaillés d'ablettes selon un procédé chimique gardé secret.

Les perles artificielles ne sont pas une exclusivité du Léman. En 1874, le zoologue Godefroy Lunel indique que la fabrication de perles à partir d'écaillés d'ablettes est fort développée à Paris. Il s'agit d'ailleurs qu'il n'y ait pas d'industrie de ce genre autour du Léman.

En 1974, la concurrence des perles artificielles japonaises entraîne la fermeture de la fabrique de Saint-Gingolph.

Grâce à des recherches récentes, on sait que le Léman a aussi ses perles naturelles. Microscopiques, elles sont produites par des microorganismes du phytoplancton.



L'ablette (bleak), Godefroy Lunel, 1869, detail of an illustration taken from the monograph Histoire naturelle des poissons du "bassin du Léman", 1969. Contours: illustrations by studio KO. Essence d'Orient (pearl essence) was made from the scales of bleak, also referred to in the region as "sardines".

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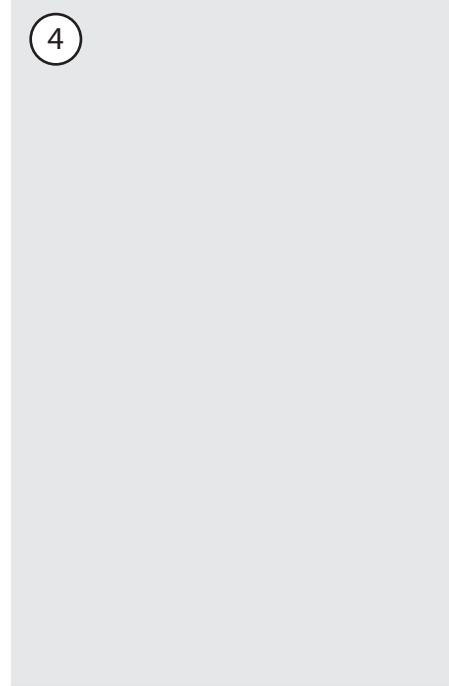
In the pearl workshop at Saint-Gingolph, Photo-Lamy-Thonon, 1950s, reproduction of a postcard. The photograph shows the Saint-Gingolph workers in the process of dipping the pearls.



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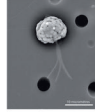
Cultured pearls from Lake Geneva at various stages of dipping, from the Saint-Gingolph factory.

Lac de Genève, Suisse, vers 1925, reproduction of a poster.



4

5



Micro-pearls from Lake Geneva photographed by means of a scanning electron microscope, Agathe Martignier, © Université de Genève/Martignier et al., 2017, Geobiology. The photograph shows a unicellular algal species called Tetraselmis cordiformis. Two micro-pearls are visible inside the cell (the two white dots).



Perle du lac, Jacomo Muller, around 1925, reprint of a poster.

Who manufactures Lake Geneva's pearls?

In the 1920s, a company for the manufacture and sale of Lake pearls came into existence in Saint-Gingolph. According to the Gazette de Lausanne in 1925, these cultured pearls were much appreciated by a variety of film-makers and actresses, and were manufactured by the metre by some sixty women workers. In order to manufacture them, enamel or porcelain cores were attached to fine copper wires which were then dipped between five and twenty-five times, depending on the quality desired, in Essence d'Orient (pearl essence), a substance produced from the scales of the bleak using a secret chemical process. Cultured pearls were not exclusive to Lake Geneva. In 1874, the zoologist Godefroy Lunel revealed that the manufacture of pearls using bleak scales flourished in Paris. Indeed, he expressed surprise that there was no industry of this type around Lake Geneva.

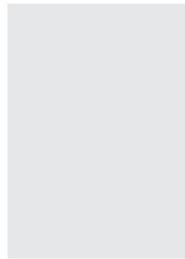
In 1974, competition from Japanese cultured pearls led to the closure of the Saint-Gingolph factory. We know from recent research that Lake Geneva also has natural pearls; they are microscopic and are produced by micro-organisms in the phytoplankton.

1. L'ablette (the bleak), Godefroy Lunel, 1869, detail of an illustration taken from the monograph Histoire naturelle des poissons du "bassin du Léman", 1969. Contours: illustrations by studio KO. Essence d'Orient (pearl essence) was made from the scales of bleak, also referred to in the region as "sardines".
2. In the pearl workshop at Saint-Gingolph, Photo-Lamy-Thonon, 1950s, reproduction of a postcard. The photograph shows the Saint-Gingolph workers in the process of dipping the pearls.
3. Cultured pearls from Lake Geneva at various stages of dipping, from the Saint-Gingolph factory.
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5. Micro-pearls from Lake Geneva photographed by means of a scanning electron microscope, Agathe Martignier, © Université de Genève/Martignier et al., 2017, Geobiology. The photograph shows a unicellular algal species called Tetraselmis cordiformis. Two micro-pearls are visible inside the cell (the two white dots).

DE L'OR NOIR DANS UN LAC BLEU ?



1



Les structures géologiques du Plateau suisse étant favorables à la production d'hydrocarbures, des premières recherches de pétrole sous le Léman ont été réalisées dans les années 1960. D'autres ont été menées dans la région par la suite sans donner de résultats suffisants pour déboucher sur une exploitation.

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Dans le courant des années 2000, l'intérêt pour les ressources potentiellement enfouies sous le lac est revenu, en raison notamment des progrès technologiques permettant de capter des sources d'énergies autrefois inaccessibles.

Un important forage exploratoire a été réalisé sur la commune de Noville (à l'extrémité est du lac) en 2009-2010, puis en 2013. Ces travaux ont permis de détecter suffisamment de gaz naturel piégé, pour alimenter toute la Suisse pendant une vingtaine d'années selon l'entreprise responsable.

Mais l'exploitation de ces gaz nécessite de fracturer ou stimuler la roche à l'aide d'eau à forte pression et de produits chimiques, ce qui pourrait engendrer des pollutions ou des tremblements de terre. A ce jour, l'exploitation des ressources enfouies sous le lac n'est pas programmée.



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4

Raffineries et bleu Léman (Refineries and a blue Lake Geneva), 1961, offprint of the "Feuille centrale", Zofingen. In the 1960s, following the installation of the Collombey refinery, various personalities were already expressing concern about the risks of oil leaks into the Rhone and from there into the Lake.

3



View of the Noville platform from the left bank of the Grand canal, Jean-Marc Fivat, 17 December 2009. The derrick (in the centre) was removed in 2014. It had been used to drill a hole extending nearly 3 kilometres under the Lake. The upper section has since been closed off. The site directly juxtaposes the Grangettes nature reserve.

Black gold in a blue Lake?

Since the geological structures of the Swiss Plateau constitute a favourable environment for the production of hydrocarbons, the 1960s saw instances of initial prospection for oil under Lake Geneva. Further explorations were conducted subsequently in the region but did not produce adequate results for initiating exploitation. During the 2000s, there was a revival of interest in the resources potentially buried below the Lake, essentially as a result of technological progress whereby sources of energy that were once unreachable can be captured. Large-scale exploratory drilling was carried out on the commune of Noville (at the end of the Lake) in 2009-2010 and again in 2013, and resulted in the detection of sufficient imprisoned natural gas to supply all of Switzerland for about twenty years, according to the company in charge. Recuperation of this gas, however, requires the fracturing or stimulation of the rock using high-pressure water jets and chemicals, which could lead to pollution or to earth tremors. No schedule exists to date for exploiting the resources buried below the Lake.

1. Various materials issued by the group of opponents of the mining of natural gas at Noville. Since March 2015, the group "Halte aux forages Vaud" (Stop Vaud drilling) has been reporting on the risks of exploiting Lake Geneva's natural gas and organises demonstrations in the canton of Vaud where the Noville base is installed.
2. L'or noir du Léman (The black gold of Lake Geneva), Archives RTS, broadcast on 17 April 1964, 2 minutes 8. In April 1964, seismic sensors were used in attempts to prospect for oil at the bottom of the Lake.
3. View of the Noville platform from the left bank of the Grand canal, Jean-Marc Fivat, 17 December 2009. The derrick (in the centre) was removed in 2014. It had been used to drill a hole extending nearly 3 kilometres under the Lake. The upper section has since been closed off. The site directly juxtaposes the Grangettes nature reserve.
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Photo: Yves Favre, Keystone, August 2009. Every 10-12 years, the Company tests its sluice gates. During the 2009 exercise, 6 million litres of water were poured into Lake Geneva in 5 minutes. With a flow of 20 000 litres per second, the transient jet of water achieved a length of 300 metres.

QUELLES ÉNERGIES LE LAC PRODUIT-IL ?

2

Photo: Yves Favre, Keystone, August 2009. Every 10-12 years, the Company tests its sluice gates. During the 2009 exercise, 6 million litres of water were poured into Lake Geneva in 5 minutes. With a flow of 20 000 litres per second, the transient jet of water achieved a length of 300 metres.

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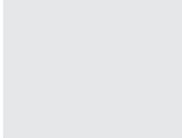


Photo: Yves Favre, Keystone, August 2009. Every 10-12 years, the Company tests its sluice gates. During the 2009 exercise, 6 million litres of water were poured into Lake Geneva in 5 minutes. With a flow of 20 000 litres per second, the transient jet of water achieved a length of 300 metres.

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5

Le Léman contribue à produire deux types d'énergie.
La première est thermique et utilise la couche d'eau profonde du lac, dont la température est relativement constante (entre 5 et 10°C). Cette eau est connectée à différents réseaux urbains pour rafraîchir ou chauffer des bâtiments. Au terme de son parcours, l'eau est restituée à son milieu naturel. La température et la qualité des eaux rejetées sont très encadrées par la législation, car une eau trop chaude ou trop chlorée (le chlore permet de ne pas endommager les installations techniques) pourrait avoir des impacts négatifs sur l'écosystème.
Utilisé depuis le début des années 1960 pour la climatisation du siège de Nestlé à Vevey, ce principe a été adopté pour le refroidissement des bâtiments de l'Université de Lausanne depuis la fin des années 1980 et depuis la fin des années 2000 pour la climatisation et le chauffage du quartier des organisations internationales à Genève.
Le second type d'énergie est mécanique et utilise l'important réservoir d'eau du Léman pour fournir de l'énergie hydroélectrique. Au Vevey, près du Château de Chillon, les Forces motrices Hongrin-Léman pompent l'eau du lac, depuis 1971 pour la stocker dans le lac artificiel de l'Hongrin à 1255 mètres d'altitude. Lorsque l'eau redescend vers le Léman, elle actionne des turbines qui produisent de l'électricité.

What energies does the Lake produce?

Lake Geneva contributes to the production of two types of energy. The first of these is thermal energy, using the deep-water layer with its relatively constant temperature (between 5 and 10°C). This water is connected to several different urban networks in order to cool or heat buildings. Once it has completed its circuit, the water is returned to its natural environment.

The temperature and quality of the water that goes back to the Lake are strictly controlled by law, since if the water is too hot or too chlorinated (chlorine ensures that the technical equipment is not damaged) it could have adverse effects on the ecosystem.

This principle has been in use since the early 1960s for the heating and cooling of Nestlé's headquarters at Vevey; it was adopted for cooling the buildings of the University of Lausanne as from the late 1980s and since the late 2000s for the cooling and heating of the district of the international organisations in Geneva. The second type of energy is mechanical, and uses the huge reservoir of water of Lake Geneva to supply hydroelectric power. At Veytaux, near the Château de Chillon, the Hongrin-Léman Power Company has been pumping water from the Lake since 1971 and storing it in the artificial Lake Hongrin at an altitude of 1255 metres. When the water flows back down to Lake Geneva, it operates turbines which produce electricity.

1. Tests by the Hongrin-Léman Power Company in front of the Château de Chillon, Dominic Favre, Keystone, August 2009. Every 10-12 years, the Company tests its sluice gates. During the 2009 exercise, 6 million litres of water were poured into Lake Geneva in 5 minutes. With a flow of 20 000 litres per second, the transient jet of water achieved a length of 300 metres.
2. Explanatory video of the Génilac project implemented by the Industrial Services Geneva (SIG) and partners, 2016, 3 minutes 35.
3. Stereoscopic photograph of the Coulouvrenière mill from the Saint-Jean cliffs at Geneva, author unknown, around 1860-70. Before the construction of Geneva's Bâtiment des forces motrices (Power Plant building), there were numerous mills on the Rhone. They were essential to life in Geneva since they supplied the city with flour. When ice immobilised them during the winter of 1788-89, there was a genuine shortage of flour.
4. Montreux, Lake Geneva, author not identified, print taken from "Picturesque Europe" published in 1879. There were large numbers of mills around Lake Geneva, but they were built on tributaries in order to make the most of stronger currents.
5. Grand vin de Lavaux, E. Margo, Epresses, 1985, reproduction of a label on a wine bottle. Lake Geneva also contributes to the production of a kind of solar energy. In Lavaux, the vines are said to take advantage of three suns – the direct rays of the sun, its rays reflected in the Lake and the low walls which at night give out the heat accumulated during the day. The coat of arms at the bottom of the label shows three vines surmounted by three suns.

PEUT-ON MARCHER SUR LE LAC?



2

En 1890-1891, le lac de Genève est gelé pendant une partie de l'hiver. Les Genevois ont pu traverser la rade à pied car l'eau y était gelée. Mais, même le jour le plus froid de ces hivers polaires, la glace ne s'est jamais étendue au-delà de la rade de Genève, ni plus loin que l'intérieur des différents ports du lac.

1

Pour le lac de Genève, la température de l'eau est la plus basse en hiver, mais elle est la plus élevée en été. C'est pourquoi le lac est stratifié de manière stable pendant une partie de l'année (été) et brassé une fois par an (fin d'hiver). Autrement dit, les eaux du Léman se distribuent en trois couches de températures : l'épilimnion qui correspond aux eaux de surface chaudes, le métalimnion ou thermocline dont l'épaisseur est de 10 à 15 mètres, et l'hypolimnion, la plus froide, qui commence selon les saisons à une profondeur de 15 à 30 mètres.

A l'automne et en hiver, les eaux de surface se refroidissent jusqu'au moment où les trois couches ont la même température. Les vents peuvent alors faire circuler le volume d'eau : les eaux de surface gagnent des éléments nutritifs provenant du fond et les eaux des profondeurs de l'oxygène de la surface. En fonction des conditions (températures et vents), le brassage peut être partiel ou complet. Les derniers brassages complets remontent à 2006 et 2012. En 2018, le brassage du lac a atteint 200 mètres de profondeur.

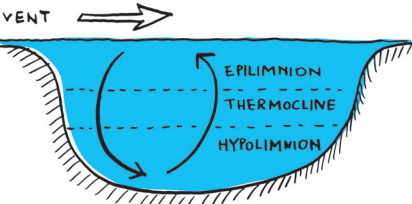
N'imaginer donc pas marcher un jour entre Lausanne et Evian, car le Léman ne peut pas geler. C'est un lac monomictique chaud, c'est-à-dire un lac stratifié de manière stable pendant une partie de l'année (été) et brassé une fois par an (fin d'hiver). Autrement dit, les eaux du Léman se distribuent en trois couches de températures : l'épilimnion qui correspond aux eaux de surface chaudes, le métalimnion ou thermocline dont l'épaisseur est de 10 à 15 mètres, et l'hypolimnion, la plus froide, qui commence selon les saisons à une profondeur de 15 à 30 mètres.

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OUI, MAIS SEULEMENT S'IL EST GELÉ

3



Can you walk on the Lake?

During the winters of 1891, 1929 and 1956, the inhabitants of Geneva were able to cross the harbour on foot because the water had turned to ice. However, even on the coldest day of these Arctic winters the ice never extended beyond that area, nor beyond the various harbours on the Lake. Don't imagine that one day you will be able to walk from Lausanne to Evian because Lake Geneva cannot freeze over. It is a warm monomictic type lake, i.e. with stable stratification during part of the year (summer) and the turnover or mixing of the water layers once a year (late winter). Put another way, there are three temperature layers in Lake Geneva: the epilimnion corresponding to warm surface water, the metalimnion (or thermocline) extending vertically between 10 and 15 metres below the epilimnion, and the hypolimnion, the coldest layer, which begins at a depth of 15 to 30 metres depending on the season. In autumn and winter, the surface water cools until the three layers are at the same temperature. The winds can then cause the volume of water to circulate: the surface water gains nutrients from the depths of the Lake and the deep water acquires oxygen from the surface. Depending on the conditions (temperature and winds), the mixing may be partial or complete. The last complete turnover or mixing events go back to 2006 and 2012. In 2018, the mixing of the water layers reached a depth of 200 metres.

1. Geneva harbour frozen during the winter of 1890-1891, author unknown and Emile Pricam, photograph. That winter, a temperature falling below -10°C and a strong "bise" caused the formation of a layer of ice as much as 13 centimetres thick in Geneva. The "freezing of the Lake", as it was called at the time, allowed the bravest inhabitants to walk across the harbour.
2. La Pêche miraculeuse (The Miraculous Draught of Fishes), Konrad Witz, 1444, Geneva Museum of Art and History, photograph by Flora Bevilacqua. This work is considered to be the first representation of an identifiable landscape in the history of art. The harbour area of Geneva, the Voirons, the Môle, the Salève, the Pierres de Niton, etc. are all visible. Among the persons depicted, Saint Peter swims towards Jesus who is walking on the water.
3. Stratification of the Lake's three temperature layers, studio KO, 2018. During very cold winters, the top layer of the Lake cools and the water becomes denser. Under the influence of the wind it penetrates down to the bottom of the Lake creating vertical currents and mixing the water layers.

DES MUNITIONS DANS LE LÉMAN ?

Bien que la Suisse n'ait pas participé aux conflits armés du 20^{ème} siècle, elle a fonctionné avec une économie de guerre et produit de l'armement. A l'issue des deux guerres mondiales, le pays disposait d'importants stocks de munitions, en bon état, obsolètes ou défectueux, qu'il était nécessaire d'éliminer. Or, la destruction de munitions demande des investissements techniques et financiers importants. Pour trouver une solution rapide au risque d'explosion, 8000 tonnes de munitions ont été immergées dans le Léman genevois.

Il y a eu trois phases historiques d'immersion dans le Léman. En 1928, entre 1960 et 1970 environ, puis en 1979. Les lieux exacts de ces immersions ne sont pas connus mais les témoignages indiquent qu'elles ont eu lieu dans le Léman genevois.

La présence de ces munitions est découverte à plusieurs reprises, par exemple en 1989 au cours d'une plongée technique. En 2004, l'Armée suisse pilote une étude qui répertorie les différentes immersions dans les lacs suisses. Mais la première étude historique officielle est menée par l'Université de Genève en 2021.

En 2020, l'Université de Genève réalise une deuxième étude avec l'aide de plongeurs de l'association Odysseus 3.1 afin d'étudier les éventuels impacts environnementaux de ces munitions sur le milieu lacustre. Les résultats, bien que préliminaires et exploratoires, ont mis en évidence une augmentation de la concentration en métaux lourds à proximité directe des munitions immergées, prouvant que le processus de corrosion des munitions est en cours. Suite à ce travail, l'Etat de Genève a inscrit en 2021 une grande partie du Léman genevois dans le cadastre des sites pollués afin de mener ses études requises par la loi.

La Suisse ne fait pas figure d'exception. On estime le volume de munitions qui reposent dans les lacs ou sur les fonds marins à travers le monde entre plusieurs centaines de milliers et trois milliards de tonnes.

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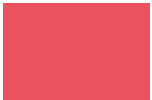
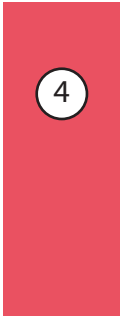
Les munitions immergées dans les lacs suisses pendant la Seconde Guerre mondiale ont été découvertes en 1989 au cours d'une plongée technique.



En 2004, l'Armée suisse pilote une étude qui répertorie les différentes immersions dans les lacs suisses.



En 1928, entre 1960 et 1970 environ, puis en 1979, des munitions ont été immergées dans le Léman genevois.



Munitions in lake Geneva ?

Although Switzerland took no part in the armed conflicts of the 20th century, it functioned with a war economy and produced armaments. Following the two World Wars, Switzerland possessed considerable stocks of munitions – in good condition, obsolete or defective – which it needed to dispose of. The destruction of munitions, however, requires major technical and financial investments. In order to come up with a rapid solution to the risk of explosion, 8000 tonnes of munitions were dumped in the Swiss lakes after the Second World War.

Over time there were three main phases of munitions dumping in Lake Geneva: in 1928, at some point between 1960 and 1970, then in 1979. The exact sites are not known but evidence exists that it was in Lake Geneva that these instances of dumping took place.

The presence of the munitions was discovered on a number of occasions, for example, in 1989 during a technical dive. In 2004, the Swiss Army piloted a study listing the various instances of dumping in Swiss lakes. The first detailed historical study, however, was carried out by Geneva University in 2017.

The same university made a second study in 2020 with the assistance of divers from the Odysseus 3.1 Association, in order to study the possible ecological impact of the munitions on the environment of the lake. Although these are only preliminary and exploratory results, they reveal an increase in the concentration of heavy metals in the immediate proximity of the submerged munitions, confirming that the process of corrosion has begun. As a consequence, the State of Geneva included a large area of the Geneva section of Lake Geneva in its register of polluted sites late in 2021 in order to carry out the studies required by law.

Switzerland is no exception. It is estimated that the munitions to be found in lakes or on the sea bed throughout the world account for a volume of between several hundreds of thousands and three billion tonnes.

1. Comic strip book, "Les munitions du Léman" (The munitions of Lake Geneva), a comic book by Joris Bayon (scenario), Lionel Rard (scenario) and Nicolas Otero (cartoonist), Editions Perspectives Art9 et Odysseus 3.1, 2022, 47 pp. This first comic book by the Odysseus 3.1 Association tells an action-packed tale of suspense in the search for munitions in Lake Geneva.

2. Screen, TV news report on JT 12-13 de Midi Grenoble, broadcast in the France 3 region, "édition Alpes", on 10 November 2020, Archive INA. Duration: 3 minutes 12.

3. Army document, Regulation concerning "Le service des munitions à la troupe, le ravitailleur en munitions" (Army munitions department, munitions supply), of 1 August 1964, art.70, §d. The disposal of munitions by dumping was part of the methods of the Swiss army in the 1960s, and a regulation existed setting out the necessary conditions. It may be noted that the dumping of munitions by the army, mainly in Lake Thun, Lake Uri, Lake Brienz and the Four Cantons Lake is currently undergoing a process of elimination and depollution by the army.

4. Grenades
 Anti-tank grenades manufactured by the private local Hispano-Suiza company during the Second World War. From 1960 until around 1970, between 150 and 1000 tonnes of munitions manufactured by this company were dumped in the lake. Earlier, in 1928, 83 phosgene gas bombs, manufactured in France and imported during the First World War, had already been dumped. In 1979, between 1000 and 10,000 rounds of ammunition for guns were dumped in the lake following an army air defence course. All these instances of dumping were completely legal.

PEUT-IL Y AVOIR LE FEU AU LAC ?

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Les jours de beau temps, lorsque le soleil se couche, le ciel au-dessus du Léman prend souvent une teinte rouge-orangée qui donne l'impression que le lac s'embrase. Ce phénomène s'explique par la position du soleil. Lorsqu'il se couche et n'est donc plus à la verticale, sa lumière doit traverser une épaisseur d'atmosphère 12 fois plus importante qu'à midi. Cette-ci retient les couleurs à courtes longueurs d'onde, comme le bleu, le vert et le jaune. Des sept couleurs qui composent la lumière blanche du soleil, notre œil ne perçoit alors plus que l'orange et le rouge.

On raconte que les bergers attendaient l'embrasement du ciel au-dessus du Léman pour savoir quand partir traire leurs vaches. Ainsi serait née, dans la seconde moitié du 19^e siècle, l'expression populaire « Il n'y a pas le feu au lac » qui signifie « rien ne presse ».

L'expression a pris une nouvelle dimension suite à la destruction par le feu du Casino de Montreux le 4 décembre 1971. Ce soir-là, un incendie se déclara au milieu du concert du musicien Frank Zappa et détruisit le bâtiment situé à quelques mètres à peine du lac.

« Les musiciens du groupe Deep Purple qui assistaient à la scène s'en inspirèrent pour écrire l'une des plus célèbres chansons rock du monde » - Smoke on the water. Le refrain rappelle les impressions des spectateurs - smoke on the water, fire in the sky - en français : « fumée sur l'eau, feu dans le ciel ».

1. Le feu au lac, Plonk & Replonk, 2008.

2. Les blagues suisses (Swiss jokes), "Y'a pas le feu au lac", L. Penetier and B. Madaule, 2008, Editions Delcourt.

3. 45 rpm record jacket, "Smoke on the water", Deep Purple, 1972.

4. Fire at Montreux Casino during Frank Zappa's concert on 4 December 1971, author unknown, Montreux Museum, René Koenig collection.

5. Coucher de soleil sur le Léman (Sunset over Lake Geneva), Gustave Courbet (1819-1877), 1874, reproduction of an oil on canvas (54.5 x 65.4 cm), Musée Jenisch Vevey collection (the gift of Juliette Courbet, the artist's sister).

Can the Lake catch fire?

On fine days, when the sun sets, the sky over Lake Geneva often takes on a red-orange hue that makes it look as if the Lake were on fire. This can be explained by the position of the sun. When it sets and is no longer at the vertical, the atmosphere penetrated by its light is twelve times thicker than at midday; the shorter wavelengths (colours) of blue, green and yellow are scattered, and of the seven colours that make up the white light of the sun, the human eye can now only see orange and red. They say that the cowherds used to wait for the sky to turn fiery over Lake Geneva to know when to go and milk their cows, and that this gave rise, in the second half of the 19th century, to the popular expression “Il n’y a pas le feu au lac”, which means “There’s no hurry”. The expression took on a new significance when the Montreux Casino burned down on 4 December 1971. On that evening, a fire broke out in the middle of musician Frank Zappa’s concert and ravaged the building situated only metres from the Lake. The musicians of Deep Purple who were there used the event as inspiration for “Smoke on the water”, one of the most famous rock songs in the world. The refrain recalls the impressions of those who witnessed the event: “Smoke on the water, fire in the sky”.

1. Le feu au lac, Plonk & Replonk, 2008. An old postcard given a new use for the exhibition “La face cachée du Léman”.
2. Les blagues suisses (Swiss jokes), “Y’a pas le feu au lac”, L. Penetier and B. Madaule, 2008, Editions Delcourt. The authors chose this emblematic expression for the title of their comic book, bringing together the best popular ideas and clichés about the Swiss.
3. 45 rpm record jacket, “Smoke on the water”, Deep Purple, 1972.
4. Fire at Montreux Casino during Frank Zappa’s concert on 4 December 1971, author unknown, Montreux Museum, René Koenig collection.
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QUI SOUFFLE SUR LE LÉMAN ?

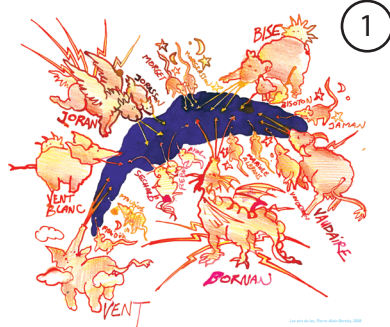
Sur le Léman, les vents du lac s'appellent traditionnellement des «airs». Ils sont nombreux - une trentaine - et variés (en intensité, orientation et appellation). Leur apparition s'explique par la présence des hautes pressions et dépressions atmosphériques, par des mouvements d'airs locaux, par des brises thermiques ou vents d'orage.

Tous les airs du lac ont en commun les préoccupations qu'ils suscitent. Leur intensité, parfois tempétueuse et soudaine, nécessite une connaissance et une vigilance accrues. Leurs noms proviennent de l'observation minutieuse de leurs tempéraments et de leurs provenances.

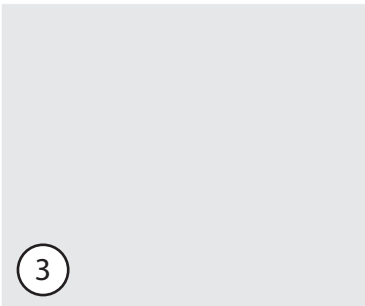
Le vent, appelé autrefois sudois, souffle depuis le sud-ouest, sous l'élan des perturbations atlantiques. Si grand parfois le nom de vent blanc quand le temps reste beau. Sa chaleur fait facilement augmenter la température de 3 à 4°C. La bise, vent froid du nord était souvent nommé Notre-Dame, car elle souffle sur le lac depuis la cathédrale de Lausanne vers Genève. Synonyme en principe de beau temps, elle est appelée bise noire lorsqu'elle apporte nuages et précipitations. La vaudaire, fille du foehn qui s'engouffre dans la vallée du Rhône, tient son nom de sa provenance valaisanne.

Joran, molan, jaman, boran, dézaley, ou morget s'associent aisément aux montagnes ou vallées qui cerrent le lac. Ils prennent parfois des consonances plus douces quand leur intensité ou leur orientation se modifie: jorasson, vauderon, morgéasson ou molaine. Enfin, il y a les gentils, ceux dont on ne craint jamais les souffles, qui se décrivent par effet qu'ils produisent: le séchard (qui assèche), le fraidieu (fraicheur), le maurablia (qui fait mûrir les blés) ou le rebat (qui s'oppose), sans oublier la chamoisine sur le Haut-Lac, qui la nuit rapetierait le souffle des chamois du sommet des Mémises.

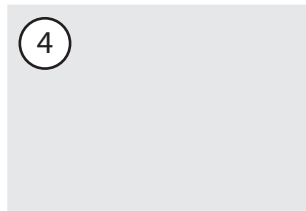
LES AIRS DU LAC
MUSEE DU LEMAN
MON-SUISSE



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4

Who or what blows on Lake Geneva?

The winds on Lake Geneva are traditionally known as “airs” (breezes). They are many – around thirty – and varied (in intensity, direction and designation). Their appearance can be explained by the presence in the atmosphere of high-pressure areas or depressions, and by the movement of local breezes, thermal winds or storm winds.

Common to all the Lake winds are the concerns to which they give rise. They may on occasion be both stormy and sudden in intensity, requiring up-to-date knowledge and a high level of awareness. Their names come from detailed observation of their nature and origins.

The “vent”, formerly known as the “sudois”, blows from the south-west, influenced by Atlantic disturbances. When the weather remains fine it is sometimes known as the “vent blanc” (white wind). As a warm wind it regularly increases the temperature by 3 to 4°C. The “bise”, a cold wind from the north, used to be referred to as “Notre-Dame” because it blows down the Lake from Lausanne cathedral to Geneva. While it generally signifies fine weather, it is referred to as the “bise noire” when it brings clouds and rain. The “vaudaire”, derived from the “foehn” which sweeps through the Rhone valley, takes its name from its origins in the canton of Valais.

The “joran”, “molan”, “jaman”, “boran”, “dézailey” and “morget” are closely associated with the mountains and valleys surrounding the Lake. Sometimes their names become gentler-sounding when their intensity or direction changes: “jorasson”, “vauderon”, “morgéasson” or “molaine”. Lastly, there are the gentle breezes which do not cause concern and are described according to the effect they produce: the “séchard” (a drying wind), the “fraidieu” (a cool wind), the “maurablia” (which ripens the wheat) and the “rebat” (an onshore wind), not forgetting the “chamoisine” on the Upper Lake, a nocturnal breeze that allegedly suggests the breath of the chamois on the summit of the Mémises.

1. Les airs du lac, Pierre-Alain Bertola, 2008.
2. Rotating vane or windmill anemometer by Casartelli & Son, early 20th century, History of Science Museum (Geneva) collection. This is a portable anemometer that is placed facing into the wind. A rev counter records the number of revolutions of the propeller over a given time. The number of revolutions recorded gives the force of the wind.
3. Map of Lake Geneva's winds, R. Gottschall, 1960. Numerous maps display the winds and breezes on Lake Geneva. Some of them, intended for sailors, are serviceable, while others are simply artistic productions.
4. Vents du Léman (Lake Geneva winds), Maité Bournoud-Schorp, ca. 1930, etching.



1

Y A-T-IL DES ALGUES DANS LE LÉMAN?

Il y a des algues dans le Léman. Elles sont flottantes et microscopiques ou liées sur des rochers, des cordages, des bouées d'amarrage où elles forment des tapis filamenteux. Plus de 1 000 espèces ont été recensées dans le Léman.

Mais le lac héberge d'autres végétaux, comme les plantes aquatiques, qui ont, contrairement aux algues, des tiges et des feuilles. On distingue les plantes émergentes (les roseières par exemple) des espèces aux feuilles flottantes comme les renouées, et des herbiers submergés.

Ces derniers constituent la majorité de la végétation du lac. Ils se développent sur le fond des zones littorales peu profondes où la lumière est suffisante. On peut observer plusieurs espèces de macrophytes (plantes visibles à l'œil nu) provenant de quatre groupes principaux: les diadées, les myriophyllies, les potamoets et les characées.

Entre avril et novembre, les herbiers submergés forment de véritables prairies sous-lacustres qui offrent une multitude de services à la faune du lac: support, refuge, source de nourriture ou encore lieu de reproduction. Des escargots aux fougères, en passant par les larves de libellules et les brochettes, tous utilisent ce «poumon du Léman».

Malgré leur rôle essentiel pour l'écosystème, les plantes aquatiques ne sont pas du goût de tous. Elles gênent la navigation, en s'emballant dans les hélices des bateaux, et dérangent les baigneurs. A divers endroits du lac, les plantes aquatiques sont fauchées et évacuées grâce à une faucheuseuse 150 tonnes par an à Genève!



Photo: Jean-Marc Besson, Jean-Marc Besson (2015)

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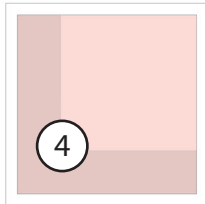


Photo: Jean-Marc Besson, Jean-Marc Besson (2015)



6

Are there algae in Lake Geneva?

There are algae in Lake Geneva – microscopic algae that float or that have attached to rocks, ropes and mooring buoys, forming carpets of filaments. More than 1 000 species have been registered in the Lake. It does, however, host other forms of vegetation, such as aquatic plants which, unlike algae, have stems and leaves. Emergent plants (reedbeds, for example) are differentiated from species with floating leaves (like waterlilies) and submerged seagrasses. Seagrasses comprise the greater part of the vegetation of the Lake. They develop in the shallows along the shores where there is sufficient light. Several species of macrophytes (plants visible to the naked eye) belonging to four main groups can be identified: Elodea (waterweed), Myriophyllum (water milfoil), Potamogeton (pondweed) and Charales (stonewort). Between April and November the submerged seagrasses form veritable underwater meadows which supply a host of services to the Lake's animal life: support, refuge, a source of food or a place to breed. From snails to coots, from dragonfly larvae to pike, they all make use of Lake Geneva's "green lung". Despite their essential role for the ecosystem, aquatic plants are not to everyone's liking. They get in the way of traffic on the Lake by becoming tangled in boat propellers, and are a nuisance for swimmers. At various points on the Lake the aquatic plants are mowed down and removed using a weed-cutter (150 tonnes annually in Geneva).

1. Shining pondweed (Potamogeton lucens), Rémi Masson.

2. Spiked water milfoil (Myriophyllum spicatum), Rémi Masson.

3. Canadian waterweed (Elodea canadensis), Rémi Masson.

4. Selection of Lake Geneva phytoplankton species, from left to right and from top to bottom: Aphanizomenon flos aquae, Planktothrix rubescens, Asterionella formosa and Volvox globator.

Phytoplankton is the microscopic vegetation in the water that drifts with the currents. It is composed of cyanobacteria (bacteria that perform photosynthesis, like plants and algae) and micro-algae. Many cyanobacteria are also mistakenly referred to as algae, for example, Aphanizomenon flos aquae (commonly called "blue algae") and Planktothrix rubescens, two potentially toxic cyanobacteria.

5. Weed-cutter in the bay of Morges, Jean Vernet, July 2015.

6. Stonewort (Chara sp.), Rémi Masson.

External - Phytoplankton cultures from samples of Lake water. Miniscule organisms are just visible; these are zooplankton, some of which are herbivores and feed off the existing phytoplankton.

FAUT-IL ARRACHER LES RENOUÉES DU JAPON ?

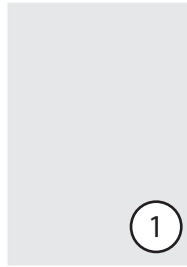
Introduite en Europe au 19^e siècle comme plante ornementale, la renouée du Japon, originaire d'Asie orientale a envahi de nombreux sites naturels en 150 ans.

A l'aise sur les bords des cours d'eau, elle a colonisé une grande partie des rives du Léman et de ses affluents, au détriment de la biodiversité locale. Sa capacité à se reproduire rapidement et à éliminer ses concurrents fait d'elle une plante particulièrement envahissante. Poussant atteinte 3 mètres de haut en quelques semaines, ses feuilles imposantes empêchent le développement des autres végétaux qu'elle prive de lumière. De plus, ses racines sécrètent des substances toxiques pour les plantes avoisinantes.

Divers moyens ont été proposés pour lutter contre cette véritable peste végétale. L'arrachage manuel, méthode la plus écologique, est appliquée par l'Association pour la Sauvegarde du Léman (ASL) depuis 2013. L'ASL conseille aussi, pour affaiblir la renouée du Japon, d'occuper l'espace et de lui faire de l'ombre en plantant des arbustes tels que le sureau noir ou le cornouiller sanguin.



3



1. Halte aux Renouées, du Japon, 2017, affiche et prospectus de l'Association pour la Sauvegarde du Léman (ASL).
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3. Halte aux Renouées, du Japon, 2017, illustrations de l'Association pour la Sauvegarde du Léman (ASL).
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Should Japanese knotweed be uprooted?

Japanese knotweed, originally from East Asia, was introduced into Europe in the 19th century as an ornamental plant and in the course of 150 years has invaded many natural sites.

At home along streams and rivers, it has colonised much of the shores of Lake Geneva and its tributaries, to the detriment of local biodiversity.

Its ability to reproduce rapidly and to eliminate competition has made it particularly invasive. It can grow to 3 metres high in a few weeks, and its imposing leaves deprive other plants of light and prevent them from developing. In addition, its roots secrete substances that are toxic to other plants in the vicinity. Various means of combating this veritable plant pest have been proposed.

The most environmentally friendly method – uprooting it by hand – has been practised since 2013 by the Association pour la Sauvegarde du Léman (ASL). In order to weaken it, the Association also recommends occupying empty spaces and over-shadowing the Japanese knotweed by planting shrubs like elderberry or dogwood.

1. “Halte aux Renouées” (Stop the knotweed), Eric Buche, 2017, poster issued by the Association pour la Sauvegarde du Léman (ASL). Every spring, the ASL organises campaigns for the uprooting of Japanese knotweed around Lake Geneva in the three cantons (Geneva, Valais and Vaud). The campaigns are open to everyone and combine outdoor activity with action on behalf of the biodiversity of the Lake.
2. Japanese knotweed and a selection of competitors, Eric Buche, 2017, illustrations from the prospectus “Halte aux Renouées”, published by the ASL. Elderberry, traveller’s joy and dogwood are bushy shrubs that compete with Japanese knotweed. The ASL recommends that they should be planted preventively or following the uprooting of the knotweed. (From top to bottom: elderberry, traveller’s joy, dogwood, knotweed).
3. Part of the beach at Tolochenaz (Vaud) invaded by a wall of Japanese knotweed (Reynoutria japonica), S. Mercier, CIPEL – International Commission for the Protection of Lake Geneva, 2014.
4. Other invasive plants around the Lake, photographs from the “Lettre du Léman”, no.48, June 2014.
From left to right:
Black locust (Robinia pseudoacacia), E. Jörg, 2006.
Cherry laurel (Prunus laurocerasus), S. Mercier, 2014.
Butterfly-bush (Buddleja davidii), S. Rometsch, 2005.

External

Japanese knotweed (Reynoutria japonica).

À QUOI SERVENT LES ROSELIÈRES ?



1

1. Rotengles à l'abri dans une roselière (Scardinius erythrophthalmus) (Common rudd sheltering in a reedbed), Robert Hainard, 1949, reproduction of a watercolour, Fondation Hainard.

Les roselières, formations végétales dominées par le roseau commun, se trouvent aux abords de lacs, d'étangs, de marais ou de cours d'eau. Autour du Léman, alors qu'elles y étaient autrefois répandues, elles occupent aujourd'hui moins de 2% de l'ensemble des rives. Leur diminution drastique est due à de nombreux facteurs : régulation du niveau du lac, transformation des rives pour les activités humaines (construction de quais par exemple), pollution, baisse du volume de sédiments apportés par les affluents (notamment parce qu'ils sont retenus par les barrages alpins), etc.

Les roselières fournissent pourtant d'immenses services écologiques. À l'interface entre la terre et l'eau, elles amortissent l'arrivée des courants et protègent les berges de l'érosion. Elles purifient l'eau en piégeant les particules en suspension. Enfin, elles participent à l'épuration du lac par l'absorption des nutriments (phosphates et nitrates) et la fixation de certains métaux lourds.

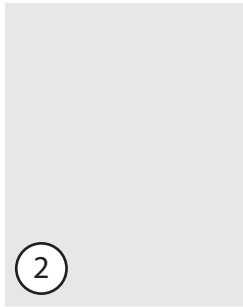
Elles sont aussi un refuge et un lieu de nourrissage pour de très nombreuses espèces : oiseaux, insectes (comme les libellules), poissons, batraciens, reptiles et même quelques mammifères, comme le rat des moines.

Pour contrer les conséquences néfastes de la disparition des roselières, des programmes de renaturation et de plantation ont été lancés : en 2007, la roselière des Fourches, sur la commune de Céligny, qui avait disparu en 2004, a été remise en état ; en 2016, 10 000 roseaux ont été plantés pour renforcer la roselière de Chens-sur-Léman.

LES ROSELIÈRES SERVENT À PROTÉGER LES BERGES DE L'ÉROSION, PURIFIER L'EAU ET ABRIER UNE CENTAINE D'ESPÈCES.



Source : D. Chappuis, 2016



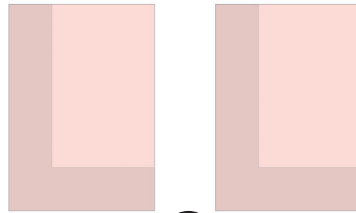
2

2. Bruant des roseaux (Emberiza schoeniclus) (Reed bunting), Robert Hainard, 1946, reproduction of an engraving, Fondation Hainard.



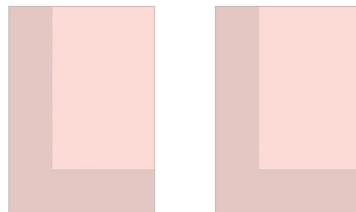
3

3. Vue de Genève depuis les Pâquis (View of Geneva from the Pâquis), author unknown, first half of the 19th century, reproduction of a watercolour, private collection.



4

4. Sélection de typiques plantes de roselière du lac Léman. Bien que les roselières le long du lac soient aujourd'hui dominées par le roseau commun, d'autres espèces peuvent également y être trouvées et contribuer à enrichir la diversité de ces environnements.

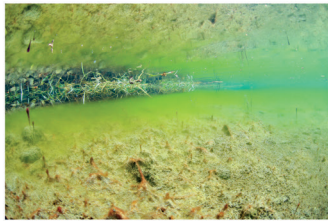


What are the reedbeds for?

Reedbeds, vegetation dominated by the common reed, are found around lakes, ponds, marshes and streams and rivers. They were once widespread around Lake Geneva, but today occupy less than 2% of the shores. Their drastic decline is due to many factors: the regulation of the level of the Lake, the transformation of the lakeshores resulting from human activities (embankment construction, for example), pollution, a decrease in the volume of sediments brought in by the tributaries (notably because the Alpine dams hold back their water), etc. However, the services the reedbeds provide to the environment are immense. Emerging at the interface between land and water they moderate the inflows to the Lake and protect its shores from erosion. They purify the water by capturing particles in suspension, and they contribute to cleaning up the Lake by absorbing nutrients (phosphates and nitrates) and by attaching to some heavy metals. They are also a refuge and feeding-ground for a great many species: birds, insects (like dragonflies), fish, amphibians, reptiles and even some mammals, like the harvest mouse. In order to counter the harmful consequences of the disappearance of the reedbeds, renaturation and planting programmes have been initiated: in 2007, Les Fourches reedbed in the commune of Céligny was resuscitated (it had disappeared in 2004); in 2016, 10 000 reeds were planted to reinforce the Chens-sur-Léman reedbed.

1. Rotengles à l'abri dans une roselière (Scardinius erythrophthalmus) (Common rudd sheltering in a reedbed), Robert Hainard, 1949, reproduction of a watercolour, Fondation Hainard. The submerged area of reedbeds is a favoured habitat and sometimes even a much-appreciated larder for many fish.
2. Bruant des roseaux (Emberiza schoeniclus) (Reed bunting), Robert Hainard, 1946, reproduction of an engraving, Fondation Hainard. The reed bunting is a regular visitor to the reedbeds along the Lake. It makes its nest on the ground, at the edge of the flooded zone.
3. Vue de Genève depuis les Pâquis (View of Geneva from the Pâquis), author unknown, first half of the 19th century, reproduction of a watercolour, private collection. There were still numerous reedbeds around the Lake. Their surface area would continue to decrease, caused essentially by the draining of the marshes.
4. Sélection de typiques plantes de roselière du lac Léman. Bien que les roselières le long du lac soient aujourd'hui dominées par le roseau commun, d'autres espèces peuvent également y être trouvées et contribuer à enrichir la diversité de ces environnements. The distribution of the different species depends on the season, the soil quality, the depth of the water and the duration of the flooding.

External - Harvest mice (Micromys minutus). Europe's tiniest rodent (approximately 7 grammes) is particularly fond of the reedbeds along the Lake. It excels at climbing, and easily scales the reed stems in search of seeds, berries and small insects. Although they are not an endangered species, they are very sensitive to pollution, especially from intensive farming, and the increased scarcity of their habitat.



1

LE LÉMAN SE RÉCHAUFFE-T-IL ?

LE JOURNAL DES BAINS



L'eau de surface du lac a augmenté de 2.5°C en moyenne entre 1970 et 2015. En profondeur, ce réchauffement est moins fort mais bien réel: environ 1°C supplémentaire dans la couche la plus profonde, à 309 mètres.

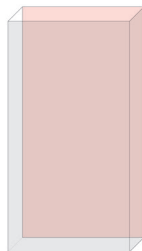
Toutes les conséquences du réchauffement du lac ne sont pas encore connues, mais des risques sont déjà identifiés, comme la diminution des concentrations en oxygène dans les couches profondes, compromettant le maintien de la vie aquatique qui s'y trouve. Car, il faut un brassage complet des eaux pour que l'oxygène des couches supérieures du lac atteigne les plus grands fonds. Comme le brassage complet dépend du froid (voir la question "Peut-on marcher sur le lac?"), le réchauffement climatique pourrait l'entraver. Faudra-t-il un jour oxygéner artificiellement les fonds du Léman, comme on le fait déjà dans les lacs de Hallwil, Bregence et Lucerne et de Baldegg (Lucerne)?

D'autres risques pourraient découler du réchauffement du lac, comme la prolifération d'espèces appréciant les eaux plus chaudes: silures, méduses d'eau douce ou punes de canard.



Le Journal des Bains, Guy Mérat et Anastase Liaros, comic strip published in the "Journal des Bains" produced by the Association d'usagers des Bains des Pâquis, summer 2017.

2



4

Reversing thermometer developed by Negretti & Zambra in 1874, belonging to the scientist François-Alphonse Forel (1841-1912). This mercury thermometer enables the water temperature of the deeper layers to be measured. It is resistant to water pressure thanks to its double glass tube. The fact that it can be turned upside down ensures that the deep-water measurement is not affected. When the thermometer is inverted, the mercury column corresponding to the temperature measured is broken; this means that returning the thermometer to the surface cannot influence the result.



Phytoplankton photographed in Lake Geneva in 2014, Rémi Masson. Since phytoplankton species are no more than a few micrometres in size, they are only visible to the naked eye in clusters. Global warming brings forward the spring phytoplankton peaks, with a series of consequences for the ecosystem of the Lake that are still not properly understood.

Is Lake Geneva getting warmer?

The temperature of the surface water increased on average by 2.5°C between 1970 and 2015. The rise in temperature in the deeper water is less pronounced but it exists and is approximately 1°C in the deepest water layer at 309 metres. We do not yet know all the consequences of the warming of the Lake, but some risks have already been identified, such as the reduction of oxygen concentration in the deepest layers, jeopardising the maintenance of aquatic life at that level, since a complete turnover of the water is needed for the oxygen in the upper layers of the Lake to reach the lowest sectors. Since a complete turnover depends on the cold (see the question "Can you walk on the Lake?"), climate change may interfere with this process. Will an artificial oxygenation of the lowest reaches of Lake Geneva be necessary one day, as has already been the case in the Hallwill (Aarau and Lucerne) and Baldegg (Lucerne) Lakes?

The warming of the Lake may give rise to other risks, such as the proliferation of species that prefer warmer water - catfish, freshwater jellyfish or duck fleas.

1.

Phytoplankton photographed in Lake Geneva in 2014, Rémi Masson.

Since phytoplankton species are no more than a few micrometres in size, they are only visible to the naked eye in clusters. Global warming brings forward the spring phytoplankton peaks, with a series of consequences for the ecosystem of the Lake that are still not properly understood.

2.

La guerre de l'eau (The water war), Guy Mérat and Anastase Liaros, comic strip published in the "Journal des Bains" produced by the Association d'usagers des Bains des Pâquis, summer 2017.

In this comic strip, the water has vanished from Lake Geneva. At Geneva, the Pâquis lighthouse has become an observation tower for spotting water thieves.

3.

"Meteolakes" platform, available online, Theo Baracchini, 2016, Ecole polytechnique fédérale de Lausanne. Meteolakes displays several physical parameters of Lake Geneva in real time and several days in advance (for example, temperatures, currents, etc.). It is a valuable tool for understanding how sensitive the Lake is to climate change. The images shown here give examples of characteristic situations of temperature range in the surface water (week of 26 June 2017).

4.

Reversing thermometer developed by Negretti & Zambra in 1874, belonging to the scientist François-Alphonse Forel (1841-1912). This mercury thermometer enables the water temperature of the deeper layers to be measured. It is resistant to water pressure thanks to its double glass tube. The fact that it can be turned upside down ensures that the deep-water measurement is not affected. When the thermometer is inverted, the mercury column corresponding to the temperature measured is broken; this means that returning the thermometer to the surface cannot influence the result.