

Gironde Estuary

Category: Marine and Oceanic Biomes.

Geographic Location: Atlantic Coast of France.

Summary: The Gironde Estuary is the largest estuary in western Europe, with its wealth of sediments and strong tidal regime providing habitat for diverse and abundant fish and invertebrates.

Sometimes called the Gateway to Bordeaux, the Gironde Estuary is an important biological, economic, and cultural area. Estuaries are the transition zones between the river and the sea; the combined flows of sea-spawned saltwater and river-borne freshwater provides varying balances of nutrients in the water and sediment, making estuaries among the more productive of natural habitats. The Gironde exemplifies all these estuarine characteristics.

Morphology and Hydrology

The Gironde is formed from the meeting of the Rivers Dordogne and Garonne and the Atlantic Ocean on the western coast of France. It is about 47 miles (75 kilometers) long and up to 7 miles (11 kilometers) wide. At some places, the estuary is so wide that it looks and acts like an internal sea. At other places, it is narrow enough to seem to be a simple, if navigable, river.

The sea itself occupies about 75 percent of the Gironde Estuary biome, while 10 percent of its area is covered by rivers, mudflat, sandbanks and lagoons. Forests and farm lands are five percent of its area, with meadows, dunes and beaches comprising the remaining 10 percent. This range of natural ecozones makes the estuary relatively unique; it is one of few such extensive—and relatively unspoiled for its size—natural estuaries in Europe.

Covering about 245 square miles (635 square kilometers), the Gironde is the largest estuary in Western Europe. It transports about 264,000 gallons (1 million liters) of water per second into the Atlantic Ocean. The estuary and its two rivers are so full of sediment that it generally keeps the rivers and the estuary tan in color. The estuary has a tide of between 6.5 and 16.5 feet (2 to 5 meters).

This tide increases from the mouth of the river to upstream areas on the rivers, because of the decreasing width and depth of the river. There are also strong tidal currents in the estuary. Because of the amount of sediment and the tides, sand banks and islands in the estuary are always changing.

The estuary has been altered by harbor construction, and by dredging to maintain navigation. There are about 40 harbors for industrial purposes, fishing, and recreation, most of which are located inland in the former swamps of the Gironde, offering protection from tidal currents. The navigation channels are deep, with strong currents and turbidity, and are maintained by dredging and submersible dikes. There are over 84 miles (135 kilometers) of maritime dikes throughout the Gironde area; this is more than half of all the maritime dikes in France.

Natural Communities

Much of the flora of the Gironde Estuary is found underwater. The yellow boring sponge, for example, grows to unusual sizes here, often growing to more than 3 feet (1 meter) in diameter. Elephant ear sponges may be found growing among the rocks under the waters of the estuary, as well as colonies of anemones. Along the banks, plant life includes various reeds, wild orchids, and alder forests.

The Gironde Estuary is an important migration and nesting site for birds. Birds of prey, seabirds, songbirds, and waterfowl migrate along the East Atlantic Flyway, traveling along the Atlantic coast through the estuary in the spring or autumn as they fly to and from winter destinations in Africa, Spain, and Portugal. Birds also nest year-round in the estuary, drawn by the coastal and marshland riches of invertebrates, fish, and amphibians, as well as by their preference among the fresh, brackish, or marine waters. Notable bird types found in the Gironde Estuary include skylarks, nightingales, and various stork and heron species. Minks and green turtles are some of the animals found along its banks.

The Gironde has relatively narrow diversity of fish and marine species, but those species represented are found in abundance. At least 75 fish species are known here, including important

The Mascaret

The Gironde Estuary is noted for its tidal bore, a wall-like wave at the leading edge of the incoming tide. Known locally as the Mascaret, and occurring especially with spring tides, the tidal bore when it is running twice daily applies considerable force to the banks and bottom of the waterway, extending its effects as well from the estuary into the narrower rivers. On the Garonne River, the Mascaret forms a barreling wave that can reach a height of 5 feet (1.5 meters), and can also break and reform. Water turbidity is a factor that native wildlife here has adapted to.



The photo shows the wave of a small Mascaret at the leading edge of a rising tide on a narrow river in New Brunswick, Canada. (Wikimedia/Fralambert)

commercial fish stocks such as flounder, mullet, salmon, sea trout, shad, smelt, and sturgeon. Other aquatic animals include various bivalves, white shrimp, eels, sea and river lampreys. The estuary is a valued food supply for both Bordeaux and other regions of France. Wild sturgeon was once plentiful in the estuary, providing local caviar and fish—but numbers have greatly decreased, mainly through overfishing.

Fish and benthic (bottom-dwelling) species in the Gironde have adapted to tolerate regular physical and chemical changes to the estuary's salinity, depth, silt, and oxygen levels. As a result, it can be difficult to measure the impacts of human stresses like dredging, fishing, and navigation, as species here typically can tolerate the large estuarine stresses already in place. Despite human encroachment, animal life continues to find the estuary a suitable habitat.

Threats and Conservation

The estuary was contaminated by heavy metals and other contaminants due to upstream mining operations, and this contamination has affected the ecosystems and human uses. For example, oysters are not produced in the estuary. The ecosystems in the Gironde Estuary may now be shifting from a long-time mix of freshwater and marine ecosystems to a more-marine environment. If so, Gironde Estuary could become more suitable as a base of nursery habitats for marine species, than as a key migratory corridor and nursery habitat for species seeking lower-salinity plants and faunal communities.

In addition to concerns about contaminants, a 2012 study used various models to extrapolate the potential effects of rising sea levels on six specific sites in the estuary. The long-term impacts upon the greater Bordeaux area could be profound, with some floodplains currently not generally covered by water becoming submerged, for example. Climate change is projected to threaten the Gironde Estuary in several ways. Saltwater intrusion is seen as a constant challenge, no matter what presumed rate of sea-level rise is taken into account. Storm surge damage and coastal erosion are similar outputs, regardless of the accepted or predicted rates of sea-level rise or increase in storm severity. The size of inland floodplains is also likely to be reduced, as the maritime limit moves further upstream in every model researched; the extent is a matter of degree.

The ultimate effects of global warming on species health and diversity in the Gironde Estuary biome will be linked to the human efforts applied to slow or reverse emissions of greenhouse gases, the expense taken on to build up dikes and other

water control systems, and any mitigation campaign undertaken to counter-plant affected areas with native plants that can best protect the soils and support those habitat areas designated as crucial.

There is a discussion of how to protect the estuary from future storms, which may be intensified by sea-level rise and increasing storm intensity and tides. A range of options are now being considered such as coastal defenses, managed re-alignment of the estuary, controlled flooding of areas behind the dikes, and wave damping measures in the mouth of the estuary.

The Mortagne-sur-Gironde polder and Île Nouvelle were purchased by the Coastal Protection Agency after a major 1999 storm, when they were partially flooded by the sea. The agency decided to not repair the breaches, and these two areas are now flooded with each tide cycle. These two areas have shifted their makeup to tidal salt marshes, which assist local fish in reproducing and feeding.

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Further Reading

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- Lobry, Jeremy, et al. "Structure of the Gironde Estuarine Fish Assemblages." *Aquatic Living Resources* 16, no. 2 (2003).
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Summary: The Gobi is a cold desert high in the rainshadow of the Himalayas. Its growth is alarming and is greatly affecting agricultural land.

The Gobi is the fifth-largest desert in the world, stretching across northern China and southern Mongolia for more than 500,000 square miles (1.3 million square kilometers). It is a rainshadow desert created by the Himalayan Mountains, which prevent rain-carrying clouds from reaching the Gobi on the prevailing southwesterly winds. Despite its temperature extremes and arid terrain, the Gobi is notable in history for making up a significant portion of the great Mongol Empire and containing several important cities along the Silk Road from China. It is also the source of critical scientific discoveries, including the first fossilized dinosaur eggs found on Earth.

The Gobi is known for its extreme climate; sweltering midday heat can drop to freezing temperatures at night. A shift of 60 degrees F (33 degrees C) in the space of 24 hours is not unusual. In the winter, icy Siberian winds sweep across the barren landscape with few mountains significant enough to stop their progress. Summer is the rainy season in the Gobi, but temperatures that frequently surpass 100 degrees F (38 degrees C) mean that the water does not stay for long.

The Gobi Desert is comprised of five distinct ecoregions, determined by variations in climate and topography.

Eastern Gobi Desert Steppe

The Eastern Gobi Desert Steppe ecoregion covers more than 100,000 square miles (260,000 square kilometers) at an elevation of 3,300 to 5,000 feet (1,006 to 1,524 meters). Summers in this region can be very hot, and winters are extremely cold due to winds from the north sweeping across the plains. This region receives 4 to 6 inches (102 to 152 millimeters) of precipitation per year, primarily in the summer, just enough to support drought-resistant shrubs and low grasses.

Alashan Plateau

The largest Gobi ecoregion lies to the south and southwest of the steppe. The Alashan Plateau is a

Gobi Desert

Category: Desert Biomes.

Geographic Location: Asia.