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Ceratonia siliqua, Carob

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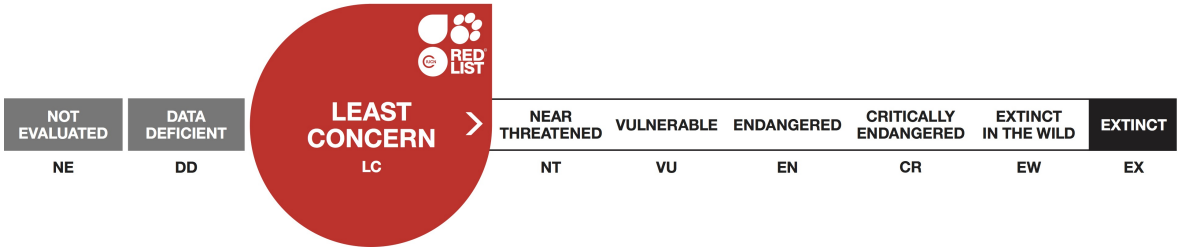

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Fabales	Fabaceae

Taxon Name: *Ceratonia siliqua* L.

Regional Assessments:

- Europe

Common Name(s):

- English: Carob
- French: Caroubier
- Spanish: Algarrobo

Taxonomic Source(s):

The Plant List. 2013. The Plant List Version 1.1. Available at: http://www.theplantlist.org/. (Accessed: July 2016).

Assessment Information

Red List Category & Criteria: Least Concern ver 3.1

Year Published: 2017

Date Assessed: March 15, 2017

Justification:

Ceratonia siliqua is a small tree with a large geographic range, native to Mediterranean Europe, North Africa, the Middle East and Turkey. The population size varies from occasional to large in most of its localities but the population is in decline due to numerous low to medium impact threats. This includes the threat from the ruthless collection of the species for domestic uses and for trade, overgrazing, deforestation, human activities and climate change.

The estimated extent of occurrence (EOO) and the estimated area of occupancy (AOO) of *Ceratonia siliqua* are greater than 20,000 km^2 and 2,000 km^2 respectively. In addition, the threats affecting the species globally are unlikely to cause the populations to decline quickly in the near future to the extent that decline would exceed the thresholds for a threatened category. A reduction in the rate of decline would also follow the implementation of the recommended conservation measures. *Ceratonia siliqua* is globally assessed as Least Concern (LC).

Geographic Range

Range Description:

The natural distribution of *Ceratonia siliqua* is still not fully understood, as it was likely to have been spread and cultivated by man millennia ago (Batlle and Tous 1997). *Ceratonia siliqua* is considered native to the Mediterranean Europe, North Africa, Turkey and the Middle East (Euro+Med 2015, WCSP

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2015, GBIF 2017). Within Asia, the range of *Ceratonia siliqua* in the wild includes; Turkey, Syria, Lebanon, Palestine, southern Jordan, Yemen, Tunisia and Libya and that it moved westward at an early stage (Batlle and Tous 1997, Boullos 1999). It is believed to have been spread by the Greeks to Italy and then by the Arabs along the coast of northern Africa into the south and east of Spain, from where it migrated to the southeast of France (Batlle and Tous 1997, Mahdad 2013).

In Europe, *Ceratonia siliqua* is found in the countries bordering the Mediterranean from south and east Spain, through southeast of France, Italy, Greece, Malta, Albania and on the Mediterranean islands such as the Balearics, Aegean Islands and Cyprus (Tutin 1964, Valdés *et al.* 1987, ILDIS 2010, GRIN 2014, Euro+Med 2015, WCSP 2017).

In North Africa, the species occurs in Morocco, Algeria, Tunisia and Libya (Charco 2001). In Algeria, *C. siliqua* occurs in Sahels coasts of Oran (O1), lowlands Oran coastlines (O2), Oran Atlas tellien (O3), Alger coastline (A1), the Algerian Atlas tellien (A2), Great Kabylie (K1), Little Kabylie (K2), Numidia (K3), Constantine C1, Saharan Atlas of Oran and Constantine (AS1-2-3) (Battandier and Trabut 1890, Quezel and Santa 1962, Medjahdi *et al.* 2009). In Morrocco, *C. siliqua* occurs in the following major floristic divisions: Atlas Mountains (High Atlas, Middle Atlas and Anti Atlas), North and Middle Atlatic of Morocco, Eastern-Land, Mediterranean Coast and Rif (Tangier, Ouezzane, Targuiset, Imzorene, Guercif, Bni-Snassen) (Négre 1961, Charco 2001, Fennane and Ibn Tattou 2005, Fennane *et al.* 2007, Valdés *et al.* 2002). In Tunisia, *C. siliqua* grew in uninterrupted expanses in the Northern (Mogods), Central (Tunisian Dorsal) areas, Northern coast (Cap Bon) and could be found also in 19 floristic divisions; Tabarka, Menzel Bourguiba, Ariana, Zbid, Khnis, Kalaa, Sayada, Jradou, Zaghouan, Enfidha, Hammamet, Jbal Rsas, Gharelmelh, Bargou, Slimen, Chbika, Belvedaire, Ain Tounga and Slouguia (Pottier-Alapetite 1979, Afif *et al.* 2008, Le Floc'h *et al*. 2010). While in Libya, *C. siliqua* occurs mainly in the Green Valley (Ali *et al*. 1989).

The range of *Ceratonia siliqua* is limited by low winter temperatures, it could be found up to 1,600 m of altitude but the average altitudinal range is from sea level up to 600 m (Batlle and Tous 1997, Charco 2001).

Ceratonia siliqua was successfully introduced elsewhere and can be found in parts of the world with a Mediterranean climate, such as in the United States of America, South Africa and Australia (Batlle and Tous 1997, Yousif and Alghzawi 2000). The total area of the Carob tree in the world is estimated at 87,485 ha of which 74,174 ha (84.81%) are distributed between Spain, Morocco, Italy and Portugal (FAOSTAT 2010). Hence, the estimated EOO and the estimated AOO exceeded the threatened categories threshold.

Country Occurrence:

Native: Albania; Algeria; Croatia; Cyprus; Egypt (Sinai); France (Corsica - Present - Origin Uncertain, France (mainland)); Greece (East Aegean Is., Greece (mainland), Kriti); Iran, Islamic Republic of; Israel; Italy (Italy (mainland), Sardegna, Sicilia); Jordan; Lebanon; Morocco; Palestinian Territory, Occupied; Portugal (Portugal (mainland)); Spain (Baleares, Spain (mainland)); Syrian Arab Republic; Tunisia; Turkey (Turkey-in-Asia, Turkey-in-Europe)

Introduced: Georgia; Monaco

Present - origin uncertain: Gibraltar; Malta

Population

Ceratonia siliqua is considered to be one of the most characteristic and dominant trees of the Mediterranean evergreen Maquis in the lowlands up to 500 m of altitude (Batlle and Tous 1997). The species' population size is currently assumed to be large and varies from occasional to abundant in most of its localities. The total area of the Carob tree in the world is estimated at 87,485 ha of which 74,174 ha (84,81%) are distributed between Spain, Morocco, Italy and Portugal (FAOSTAT 2010). In Morocco, *Ceratonia siliqua* occupies 30,000 ha in the form of natural or artificial plantations (Ait Chitt *et al.* 2007). In Tunisia, the population size is decreasing dramatically due to many threats. The populations became fragmented and scattered, and the remaining subpopulations are still threatened with further degradation (Afif *et al.* 2008).

Although the population size of *Ceratonia siliqua* is large but it is inferred to be decreasing (Cyprus Center of Environmental Research and Education 2013). This is anticipated to be because the production of Carob in the world has declined intensely over the past 60 years, decreasing from 650,000 tonnes in 1945 (Orphanos and Papaconstantinou 1969) to 205,589 tonnes in 2011 (Mahdad 2013). In Spain alone, production fell by 364,000 tonnes, declining from 420,000 tonnes in 1945 (AEA, 1987) to 56,000 tonnes in 2011. In Algeria, the production of Carob was reduced by 83% between 1961 (24,000 tonnes) and 2011 (4,000 tonnes) (FAOSTAT). Overall, the population trend of *Ceratonia siliqua* is considered to be decreasing.

Current Population Trend: Decreasing

Habitat and Ecology **(see Appendix for additional information)**

Ceratonia siliqua is a small tree (up to 10 m) that belongs to the ecosystem "Maquis of the Mediterranean littoral". *Ceratonia siliqua* prefers mild Mediterranean climates, warm temperate and subtropical areas (Batlle and Tous 1997). This is a long-lived, evergreen, xerophytic species and thermophilic tree well adapted to the ecological conditions of the Mediterranean region but tolerates hot and humid coastal areas (Batlle and Tous 1997, Charco 2001). Alongside *Pistacia lentiscus* L. and *Olea europea* var. *sylvestris,* this species forms one of the most characteristic associations of the lowest Mediterranean vegetation zone and is thus considered a climax community (Olea-Ceratonion).

Ceratonia siliqua grows well on subtropical Mediterranean climate with cool, not cold, winters, mild to warm springs, and warm to hot, dry summers (Batlle and Tous 1997, Evreinoff 1955). It is very sensitive to frost but exhibits drought resistance due to the extensive root system that penetrates to deeper water. The leaves can also maintain turgor under situations of drought, using different strategies according to the season (Batlle and Tous 1997, Evreinoff 1955). The mean annual temperature is from -4 to 40°C and the mean annual rainfalls between 250–550 mm.

This tree can grow and adapt to a wide range of soils including poor sandy soils, rocky hillsides and deep soils but prefers sandy well-drained loams and calcareous soils (Batlle and Tous 1997, Mahdad 2013). The species can tolerate salinity and high lime substrates. *Ceratonia siliqua* flowers from July to November but the time and the length of the flowering period depend on local climatic conditions. The pollination is mainly by insects; bees, flies, wasps and night-flying (Batlle and Tous 1997, Charco 2001).

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Systems: Terrestrial

Use and Trade

Ceratonia siliqua is an agro-sylvo-pastoral species with many socio-economic, ecological advantages and uses. In ancient times the seed was used as a measure of weight and the "carat" which is used as a means for measuring is thought to originate from the weight of the Carob seed (200 milligrams) (Cyprus Center of Environmental Research and Education 2013).
All parts of the tree (leaf, flower, fruit, wood, bark and root) are useful and have many values in different industries including pharmaceuticals, cosmetics (soap, creams and dentifrices) and animal feeding where the energy value of the leaf is 0.29 UF/kg of M.S, and of the pulp it is 0.6 to 0.9 UF/kg of M.S. The species can also be used for human nutrition in the form of carob syrup, ice cream, soups, sauces, cheese, fruit pies, canned meats, confectionery and bakery products. It also has medicinal and tannery uses (Bellakhdar 1997).

The main commercial use of *Ceratonia siliqua* is the production of carob ocust bean gum, a thickening or gelling agent used in food, livestock fodder and for producing alcoholic beverages. The bean is rich in carbohydrates, as well as many beneficial minerals and is an ideal nutrient source for a healthy and balanced diet. Carob pods have been used in many countries as: an antioxidant, a thickener, stabiliser or flavouring in food applications, chocolate substitute, for ethanol production, in the production of cosmetics, in animal nutrition, in lactic acid production and in medical applications (Bellakhdar 1999, Batlle and Tous 1997).

The species has also been used medicinally and pulp from the seed pod, depending on preparation, can be used as a laxative or to treat diarrhoea and also to soothe coughs (Bellakhdar 1997). A flour produced from the seed pods is used in baking and also as a base for face packs in the cosmetic industry and in pill manufacture (Batlle and Tous 1997, Plants for a Future 2014). Additional benefits of *Ceratonia siliqua* are known as the prevention of coronary heart diseases, cancer prevention, promotion of anti-allergy effects, vaso-relaxation and reduce blood cholesterol levels.
The wood of this small tree has been used for fuel and charcoal production and as it is hard and shiny is used for wood turning and products such as walking sticks. The bark of the tree is used in tannery, particularly in the completion and enamelling of skins (Batlle and Tous 1997).

Threats (see Appendix for additional information)

Although the distribution of *Ceratonia siliqua* is large, the population size is decreasing due to numerous low to medium impact threats. This includes the threat of ruthless collection for domestic uses; it is heavily collected by locals and collectors for wood, fodder, food, medicinal, domestic uses and trade (e.g. in Morocco 7 dirhams/kg for the fruit; H. Rankou and M'sou pers. comm. 2017). The species is threatened by the growing pressures from collection practices, overgrazing, deforestation, habitat loss, tourism expansion in the Mediterranean region, agricultural intensification and soil erosion.

Ceratonia siliqua is also threatened by the new management of public forests, the poorly recognition of the traditional sustainable forest management, the genetic erosion of the species genetic diversity and the replacement of the existing Carob by more intensive crop varieties (Vinterhalter *et al.* 1992).

Ceratonia siliqua is threatened more generally by long periods of drought and climate change (Benabid

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2002). The species is also impacted to some degree by minor threats, including the infection by several pests and diseases and also by the predation of Carob orchards by small rodents. In Spain, the larvae of Leopard Moths (*Zeuzera pyrina*) attacks tree trunks and branches, particularly younger trees. Pods of cultivars can also be attacked by the Carob Moth (*Myelois ceratoniae*) and by Late Blight (*Oidium ceratoniae*) (Sbay 2009). The loss this contributes to wild populations is not known.

Conservation Actions **(see Appendix for additional information)**

This tree is found in at least 16 Natura 2000 sites, for example, Giara di Siddi in Italy, and is cultivated in 115 botanic gardens worldwide (BCGI 2013, EUNIS 2014). The seed is stored *ex situ* in seed banks, such as in Cordoba, Spain (ENSCO 2014). In some areas where there have been declines protective legislation has been initiated, for example, in Cyprus in recent years, it has been included in the Forest Legislation and a permit from the Forestry Department is required in order to cut it down (Cyprus Center of Environmental Research and Education 2013).

There is ongoing research into the *in vitro* propagation of the species (Vinterhlater *et al.* 1992) but other conservations actions are recommended to protect the species and its habitats from further decline;

- Protection of the vulnerable sites from habitat loss, fragmentation, deforestation and random cutting.
- Fencing the vulnerable sites and creation of protected areas to ensure complete regeneration of the vulnerable sites
- Raising of public awareness and identifying priorities.
- Monitoring and surveillance of the existing populations and sites.
- Estimation of population sizes and study of their dynamics, trends, biology and ecology.
- Enforcement of the legal protection measures (Law on the protection and the enhancement of the environment).
- Pastoral and silvo-pastoral improvement.

Credits

Assessor(s): Rankou, H., M'SOU , S., Chadburn, H., Rivers, M.C., Ouhammou, A. & Martin, G.

Reviewer(s): Oldfield, S. & Jury, S.

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External Resources

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Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.4. Forest - Temperate	Resident	Suitable	Yes
3. Shrubland -> 3.4. Shrubland - Temperate	Resident	Suitable	-
3. Shrubland -> 3.8. Shrubland - Mediterranean-type Shrubby Vegetation	Resident	Suitable	Yes

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
1. Residential & commercial development -> 1.3. Tourism & recreation areas	Ongoing	Minority (50%)	Rapid declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
11. Climate change & severe weather -> 11.2. Droughts	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.3. Agro-industry farming	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.3. Agro-industry grazing, ranching or farming	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.1. Intentional use: (subsistence/small scale) [harvest]	Ongoing	Majority (50-90%)	Rapid declines	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions in Place
In-Place Land/Water Protection and Management
Occur in at least one PA: Yes
In-Place Species Management
Subject to ex-situ conservation: Yes

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
1. Land/water protection -> 1.1. Site/area protection
3. Species management -> 3.2. Species recovery
4. Education & awareness -> 4.3. Awareness & communications
5. Law & policy -> 5.1. Legislation -> 5.1.4. Scale unspecified

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.2. Population size, distribution & trends
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.3. Trade trends

Additional Data Fields

Distribution
Continuing decline in area of occupancy (AOO): Unknown
Extreme fluctuations in area of occupancy (AOO): No
Extreme fluctuations in extent of occurrence (EOO): No
Continuing decline in number of locations: Unknown
Extreme fluctuations in the number of locations: No
Lower elevation limit (m): 0
Upper elevation limit (m): 1600
Habitats and Ecology
Movement patterns: Not a Migrant

The IUCN Red List Partnership

The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.