Feature

Turkey's biodiversity at the crossroads

Turkey has a remarkable diversity of wildlife, due to its wide variety of habitats and unique position between three continents and three seas. Ill-considered development projects are threatening biodiversity, but a new wildlife corridor offers hope for further conservation progress. **Michael Gross** reports.

As Turkey hosts the northernmost part of the 'Fertile Crescent', where humans first developed agriculture more than 10,000 years ago, one might expect to find little wildlife left to protect after millennia of human management and exploitation of the land. On the other hand, a unique combination of geographical factors has provided Turkey with a surprisingly high level of biodiversity for a non-tropical country.

The country boasts a rich variety of landscapes, from its three coasts (bordering the Mediterranean, Aegean, and Black Seas) up to the mountains that reach 5,137 metres in height. There are forests, shrublands, large rivers, wetlands, and several mountain ranges. Turkey's unique position at the crossroads between Europe, Asia and Africa has provided an interesting mixture of species to populate these habitats. Among the carnivores, for instance, there have been wolves, bears, lynxes, leopards, along with cheetahs and even lions, although the latter two became extinct in the 19th century.

Developing threats

Even though Turkey's wildlife has weathered more than ten millennia of civilisation remarkably well, conservationists fear that recent ambitions of the Turkish government are raising the threat level. In a recent review article, Çağan Şekercioğlu from the University of Utah and colleagues have warned that "unchecked urbanisation, dam construction, draining of wetlands, poaching and excessive irrigation" are threatening Turkey's globally important biodiversity (Biological Conservation (2011) *144*, 2752–2769). In a recent letter (Science (2012) *334*, 1637–1639) Şekercioğlu and colleagues have also drawn attention to the various changes to environmental laws that have in the past two years removed remaining environmental obstacles to mining, dams, housing and other construction projects, leaving Turkey's protected areas practically defenceless in the face of such plans.

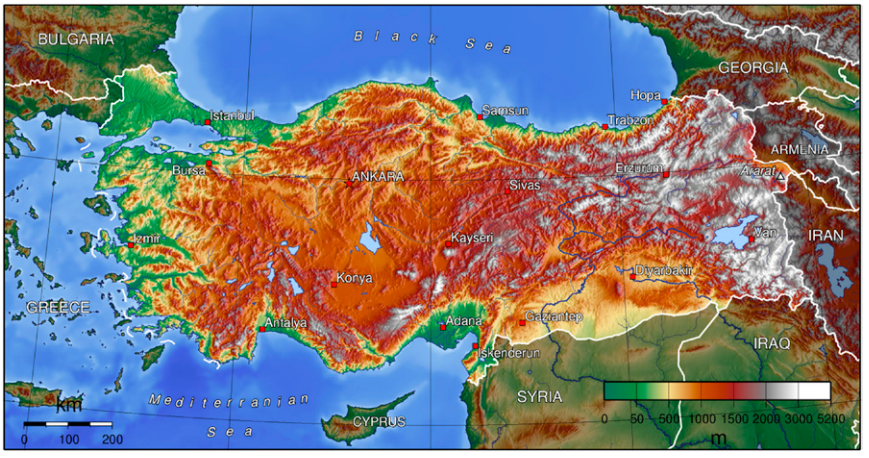
Ambitions of political leaders who want to catch up with the development level of their European neighbours, but whose narrow and outdated understanding of 'development' remains confined to extractive industries and large-scale building projects, often leave little room for conservation and environmental concerns, the authors say. Only a small number of NGOs, including KuzeyDoğa, of which Şekercioğlu is the chairman, are working to protect the natural environment.

Specifically, the review notes that Turkey's river habitats are threatened by an overenthusiastic construction of hydroelectric power plants (HEPPs) and the dams that they require. In 2007, the state hydraulic works, which build these dams and plants, were integrated into the Ministry for Environment and Forestry, meaning that there is no longer an independent assessment of any environmental damage that these projects inflict.

"Now this ministry has been divided into two ministries, Ministry for Environment and Urbanisation, where urbanisation goals dominate environmental priorities, and the Ministry of Forest and Water Affairs where dam building and timber production goals dominate the conservation agenda," Şekercioğlu explains.

If all currently planned projects go to completion, the review concludes that by 2023 nearly all of Turkey's running waters will be dammed at some point, with a total of 4,000 facilities (including power plants, diversions and dams). This development "will severely damage riparian ecosystems and will leave virtually no healthy river ecosystems, while meeting only 20% of Turkey's energy needs," the authors write.

Rather than supporting a mixture of energy sources, the state funding for renewables is almost exclusively used for hydroelectricity. The existing facilities have already affected the water quality and viability of native riparian species. Moreover, damming of the Tigris and Euphrates rivers has led to international tension, as it affects the availability of water in the downstream countries, namely Syria and Iraq.



Turkey mapped: With a dramatic combination of geological features and a variation of local climates, Turkey offers a range of different habitats for an unusually large number of species. (Image: Wikipedia.)

Mountain view: Wetlands of the river Aras, in the Kars region, northeastern Turkey, where the organisation KuzeyDoğa conducts conservation fieldwork. (Photo: Çagan Şekercioğlu.)

Forests seem to be a success for Turkey's wildlife protection, as the total forest coverage of the country has increased by 5.9% between 1973 and 2009. However, Şekercioğlu and colleagues warn of "misguided reforestation efforts that sometimes replace native vegetation with monotypic conifer plantations". Forest fires and deforestation for residential development also threaten Turkey's forests. In addition, logging of old growth forests continue, says Şekercioğlu, meaning that the increase in forest cover is in the form of young conifer plantations at the expense of old growth. "The most egregious example is the Sarıkamış National Park in eastern Turkey, which was declared to honour the 90,000 Turkish soldiers who froze to death there in the winter of 1914–15 while fighting Russians during WWI. Even though many of the slow-growing trees in this high-elevation forest are older than a century and have literally incorporated the bodies of the Turkish martyrs into their tissues, only 60 km^2 of the approximately 400 km^2 forest is part of the national park. The rest continues to be logged commercially and local people illegally cut trees in the national park," Şekercioğlu told *Current Biology*.

Along the more than 8,300 km of coastline framing Turkey from three sides, prospects are also less idyllic than they may seem in tourism brochures. Waste disposal from ships and the risk of oil spills add up to major pollution concerns. Large construction projects such as the Kanal Istanbul and the 'Two new cities' project, both near Istanbul, have worried environmentalists. In May, the government gave the go-ahead for a third road bridge across the Bosphorus, which is set to open in 2015.

However, this project also faces criticism from environmentalists, who fear that the development will threaten green areas north of the city. Most of the highway connecting to the new bridge will lead through forests. There is also the risk that it will fuel the already uncontrollable sprawl of the megacity.

"This bridge will not solve the traffic problem and may even make it worse, by encouraging the city's sprawl and promoting real estate speculation. The explosion in the number of cars in Istanbul is simply unsustainable, with people sometimes spending 5–6 hours commuting per day and parked cars turning hundreds of streets into parking lots. The solution is promoting and increasing public transport, not building more bridges that will simply expand the city and its traffic further north," Şekercioğlu comments. The population of Istanbul has grown more than fivefold in 35 years, from 2.5 million in 1975 to 13.3 million in 2010.

The rapid growth of Istanbul has also had an impact on the Marmara Sea, the connection between the Black Sea and the Aegean, which lost much of its biodiversity due to pollution and eutrophication. The much bigger Black Sea may be more resilient, but the review points out that it hosts a unique microbial biotope, namely the world's largest permanent anoxic-sulfidic body of water reaching from a depth of 100 metres down to 2,000 metres. This zone is sealed by a lid of suboxic water, known to contain unusual microbes, but there is currently very little information about life in the anoxic zone itself. Last year, a study by Claudia Wylezich and Klaus Jürgens from the Leibniz Institute for Baltic Sea Research at Warnemünde showed surprising levels of biodiversity in the sulfidic zone, concluding that the finding "emphasises the importance of anoxic, sulfidic waters as habitat for high protist diversity although the function of these organisms is yet unknown" (Environ. Microbiol. (2011) *13*, 2939–56.)

Carnivore corridor

As in other parts of the world, the loss and fragmentation of habitat has made large carnivores particularly vulnerable. Of its historic wildlife, Turkey has already lost the Asiatic lion (*Panthera leo persica*), the Iranian cheetah (*Acinonyx jubatus venaticus*), and the Caspian tiger (*Panthera tigris virgata).* Writing on the *National Geographic* blog, Çağan Şekercioğlu reports that "the Anatolian leopard (*Panthera pardus tulliana*) is on the brink of extinction." Moreover, he raises concern that "[grey] wolves, brown bears, lynx, caracals, striped hyenas and other carnivores are thought to be declining due to habitat loss, illegal poaching, car and train collisions, and taking young animals from the wild."

The existing national parks are believed to be too small to support these species. Until recently, there was a scarcity of data to support conservation work, but the

Predator's path: Caucasian lynx captured by a camera trap in the Kars region. (Photo: Kuzey-Doğa.)

organisation KuzeyDoğa has for the past few years led studies of the carnivores in northeastern Turkey. With the first wolf-tracking project in Turkey, the research showed that these predators move much more widely than the confines of the protected areas. Within just two months they covered an area that was 13 times larger than the national park where they were caught and fitted with GPS/GSM transmitters that text-message the wolves' GPS coordinates to the researchers' cell phones.

After three years of persistence, in 2011, KuzeyDoğa succeeded in convincing the government of the idea of creating wildlife corridors to connect these protected areas. The first such corridor was officially agreed with the Ministry of Forest and Water Affairs in December 2011 and publicly announced in June 2012. With a length of 82 kilometres, it will link the isolated Sarıkamış-Allahuekber National Park in the Kars region to the large Caucasus forests on the border with Georgia. With a surface area of 23,500 hectares and official status of 'Protected Forest', the corridor will be marginally larger than the national park itself.

"This corridor will provide additional habitat for large carnivores, will connect their isolated populations, and hopefully will also help reduce the local human–carnivore conflict," Şekercioğlu writes. "As Ardahan's Posof forests are connected to Georgia's Akhaltsikhe forests that border the 85,000 hectare Borjomi-Kharagauli National Park, Turkey's first wildlife corridor will also promote transboundary conservation in the region."

Two thirds of the area of the corridor is already covered by forests. The government agencies will carry out reforestation work to fill the gaps, which may take up to a decade, and hire park rangers for the protection of the area. Meanwhile, KuzeyDoğa will keep lobbying the politicians to ensure that the corridor is established as promised, and will also continue to study the ecology of the area, thus also providing a live coverage of the efficiency of the conservation measures, and to inform the public about the measures and the importance of the regional biodiversity.

Further wildlife corridors could drastically improve the value of the existing areas. "We are already talking with the ministry officials about an even bigger wildlife corridor connecting the forests on the Black Sea coast," Şekercioğlu says. "This region is mostly forested, so a thousand mile corridor crossing Turkey from Georgia to Bulgaria is not as difficult as it sounds. We also want the government to include all of Sarıkamış' remaining 400 km^2 of forest inside the boundaries of Sarıkamış National Park, not just a token 60 km^2." It looks like environmentalists in Turkey will have a lot of work to do for the coming years.

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Q & A

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Mark Johnson is an MRC Programme Leader and Director of the Centre for Brain & Cognitive Development at Birkbeck, University of London. He obtained his first degree in Biology and Psychology from the University of Edinburgh, and his PhD in Behavioural Neuroscience from Cambridge University. In between two periods working as a Research Scientist at the MRC Cognitive Development Unit, London (1985–89 and 1994–98), he was a McDonnell Foundation and Human Frontiers Research Fellow at the University of Oregon, Eugene (1989–90), and Associate Professor of Cognitive Neuroscience at Carnegie Mellon University, Pittsburgh, USA (1991–95). He has published over 250 papers and 11 books on brain and cognitive development in human infants and other species, and has been Co-Editor of the leading journal Developmental Science *since 2001. His laboratory currently focuses on typical and atypical functional brain development in human infants and toddlers using several different brain imaging, behavioural and modelling techniques. He is a Fellow of the British Academy, and has received awards including the Queen's Anniversary Prize for Higher Education, the British Psychological Society President's Award, and the Experimental Psychology Society Mid-Career Award.*

What turned you on to biology in the first place? As a boy I considered several glamour professions — pilot, architect, sportsman, musician — but at the age of 13 or so I read some popular science books on the brain and mind, and was hooked. I decided from that point on to dedicate myself to the scientific investigation of how the physical jelly of the brain gives rise to the richness and complexity of the internal human mind, and the related 'big' question of how things got to be that way in the first place. Combining brain–mind questions with those of evolution and development seemed a good, and still relatively unexplored, place to go.