

## REGULATION ON PROTECTED AREAS OVERFLIGHT IN SPAIN: CURRENT OUTLOOK AND NEXT STEPS

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## ABSTRACT

Aviation can have impacts on wildlife that should be taken into account, especially in natural areas. Limitations on aircraft overflight in natural areas can reduce impacts and promote conservation of biodiversity. In Spain, a coordinated effort has been made by the different administrations to improve aviation regulation in protected areas. We analyse the trend in operational regulations that have been legally established in protected areas in Spain and outline a newly established framework for proposing new regulations for aviation in protected areas. There was an increase in the area under regulation from the 1980s, plateauing from the 2010s. Similarly, the growth in the number of sites with new regulations has slowed from the 1990s because regulation in protected areas has been progressively addressed and the need for regulations in new sites has declined. However, the number of sites subject to authorisation for flights has increased from the 2000s. The average minimum height established for overflight of protected areas has increased in the last two decades. Based on available evidence, we propose general criteria on heights and distances in protected areas that allow coexistence between aviation and wildlife. After consultation with the relevant groups, we got the different public administrations involved to commit to include these general criteria in their regulations. We consider our experience fully transferable to other countries.

Key words: aerial regulations, aviation, air transit restrictions, wildlife

### **INTRODUCTION**

There are two main ways in which aviation interacts with wildlife: direct interactions of aircraft with wildlife and interactions of aviation with the environment. Direct interactions such as wildlife strike and wildlife control activities (Allan, 2002) mainly occur at and around airports. Wildlife strike has received more attention and research probably due to the associated repair costs, operational consequences and, in some cases, human fatalities (El-Sayed, 2019; Arrondo et al., 2021). Wildlife control at airports has arisen as a discipline due to its economic and safety importance. It includes many aspects concerning habitat management (Washburn & Seamans, 2004 ICAO, 2012; Blackwell et al., 2013) and especially avoiding avian perching (Avery & Genchi, 2004; Seamans et al., 2007), and relies on several areas of study such as bird physiology (Fernández-Juricic et al., 2011) and bird behaviour (DeVault et al., 2014).

However, interactions between aviation and wildlife habitats are probably more relevant to protected areas management. Due to its impact on people, noise is

probably one of the best-known issues. It impacts people's health (Pepper et al., 2003; Jarup et al., 2008) and causes wildlife disturbance (Shannon et al., 2016; Sierro et al., 2017). Anthropogenic noise is present in almost every protected area (Buxton et al., 2017), causing actual and potential disturbance to wildlife (Alquezar & Macedo, 2019). The impact of such disturbance on wildlife can have both individual and population-level effects. At the individual level, noise can cause variations in behaviour, and thus an extra expenditure of energy when moving to safe areas, affecting fitness and breeding performance (González et al., 2006; Gill, 2007; Margalida et al., 2007; Gladalski et al., 2016). At a physiological level, there may also be more subtle effects, such as the activation of the stress response, producing high levels of glucocorticoids that lead to the depletion of energy reserves, generating a loss of body condition, which can affect breeding and demographic parameters (Thiel, 2007; Price, 2008; Glądalski et al., 2016). Moreover, prolonged disturbance can cause negative effects at the population level, compromising the conservation status of the affected local populations, and determining the presence or absence of the species in a given place (Gill et al., 1996; Gill & Sutherland, 1999). High levels of disturbance can cause the simplification of communities towards subsets dominated by the most generalist and tolerant species, as well as the displacement of the most sensitive ones towards areas with fewer disturbances (Fernández-Juricic, 2002; Bautista et al., 2003). In addition, there is variability in the animal response to aircraft perturbation depending on the species, type of aircraft and its characteristics (i.e. size, shape), being greater large, noisy aircraft such as military helicopters or large Unmanned Aerial Systems (UAS hereafter).

The most common approach for analysing aviationcaused disturbance to wildlife is based on the aircraft type. As a new technology, there has been a focus on understanding the interaction between wildlife and UAS in recent times (Smith et al., 2016; Lyons et al., 2017; Mulero-Pázmany et al., 2017; Mustafa et al., 2018). Helicopter noise has also received great attention (Delaney et al., 1999; Tracey & Fleming, 2007; Grigolatto et al., 2018). There are other aircraft types with potential effects on wildlife that have been less studied, such as glider planes or hang-gliders (nonetheless see Hamr, 1988 Tobajas et al., 2022).

In Spain, aviation is regulated at a national level by Transport Department authorities, and specifically by the General Directorate on Civil Aviation, within the framework of the Single European Sky (Calleja & Mendes, 2011). Regional environmental authorities manage almost all the terrestrial protected areas. Regulations on the overflight of protected areas were introduced in 1983, and since then most of the legislation has been approved by these regional governments. In 2018, a national-level regulation established the need to harmonise these regional regulations through the definition and implementation of common criteria for aircraft overflight over protected areas. To that end, the General Directorate of Biodiversity, and Desertification Forests was responsible for coordinating the different approaches for establishing requirements for aircraft operations in protected areas and gathering them in a single proposal to be discussed with aviation authorities. The new requirements for aircraft operations in protected areas, with the purpose of avoiding harmful effects to wildlife, are proposed by regional authorities and then approved by a joint commission of Civil and Military Aviation authorities (CIDETRA). This framework is the result of collaboration between different administrations on a framework for establishing future regulations for aviation to ensure proper enforcement of nature conservation legislation in protected areas (Figure 1).



Figure 1. Overview of methodological steps followed to develop the overflight restriction proposal

Our goal in this paper is to summarise the trend in regulations to aviation in Spain and to present the newly established framework for regulations.

## **METHODS**

## Operational regulation database in protected areas

We asked the regional governments for all current inforce regulations for aviation in protected areas which included both terrestrial and marine environments. We built a database containing all sites and regulations (see Supplementary Material). We separated the different aviation types into six categories: 1) commercial aviation, 2) general aviation, 3) helicopters, 4) glider planes and hang-gliders, 5) balloons and 6) UAS (including model airplanes). We characterised the height above ground level (AGL), for which there are restrictions for each protected area and aviation type. If heights referred to an absolute value (above sea level, ASL), we looked for the highest place in each protected area and established the restriction as this height ASL minus the maximum height of the terrain. For example, in Ordesa National Park, aviation is restricted to 4000 metres ASL; as the highest peak reaches 3,355 m, we considered 645 m as the actual restriction. The database was reviewed and agreed by the regional governments.

## Temporal trend of aviation regulations in Spain

In order to analyse the trend in aviation regulation, we used decades as the time units between 1980 and 2019 to show how the average flight height has evolved per aviation type, how many regulations have been



approved, and how the overall protected areas under regulation has increased or decreased across the period. If there were different regulations being implemented in the same protected areas, we selected the least restrictive for the aviation activity because this is the one that prevails.

# Development of overflight restriction guidelines

Beyond the collection of in-force regulations, we reviewed documented disturbances to wildlife due to aviation and the minimum height and distance at which disturbances had been observed (Tobajas & Margalida, 2020). The review was designed to consider the different aviation types, the habitat, the group of species, and the effects of the disturbance. From the data provided by the review, it was possible to know the heights and distances at which different groups of species react to the flight of different aircraft types. As a result, this allowed us to establish the heights and flight distances in protected areas in order to minimise the possible negative effects on wildlife. The work resulted in several recommendations for establishing overflight restrictions considering the habitat, the species and the aviation types. Based on these recommendations, we started to draft proposals on overflight restrictions (Figure 1). These results were initially discussed between the national environmental administration (Ministry for Ecological Transition) and the General Directorate of Civil Aviation (Ministry of Transport). We then consulted the regional environmental authorities. Once we had the main remarks and constraints from the regional authorities, we discussed these changes with the General Directorate of Civil Aviation and with ENAIRE, the air navigation and aeronautical information service provider in Spain, and

finally presented this last version to the regional authorities.

### RESULTS

We found 603 protected areas under regulation in Spain. Of these, 36 sites were subject to two different regulations, as they were protected through a more general Natura 2000 management plan and a sitespecific protected area plan. Therefore 15 per cent of the 4,086 existing protected areas in Spain are under regulation (UNEP-WCMC-IUCN, 2021), based on 234 regulations dating from 1983. In 98 per cent of sites, the regulations are defined year-round. In 84 per cent of sites, the regulations include some kind of zoning within the protected areas.

## Temporal trend in aviation regulations in Spain

Data showed a steep increase in the area under regulation over time (Figure 2). The initial regulations of the 1980s were established for a very limited number of protected areas, mostly National Parks and other wetlands declared as Natural Parks. Since then, the area under new regulation has increased by up to 307,657 hectares per year to cover approximately 6.5 million hectares (13 per cent of the terrestrial surface of Spain). The number of regulations that came into force per decade also tended to increase, with the exception of the last decade (Figure 2).

The number of sites with new regulations published has decreased since the 1990s because regulation in protected areas has been progressively addressed and the need for regulations in new sites has declined (Figure 3). On the other hand, the average height and the number of sites where aviation is prohibited or subject to authorisation has increased over time (Figure 3). While there is only one site that requires authorisation for commercial aviation, the need for



Figure 2: Number of regulations on aviation overflight for protected areas in Spain that came into force and total number of hectares under regulation. Data are grouped per decade (1980–2019)

DISCUSSION

specific procedures on general aviation and helicopters overflight followed a similar pattern: some bans in the 2000s, fewer in the 2010s, and an increase in the same period in the number of sites requiring an authorisation. This pattern is even more acute in the case of glider planes and hang-gliders, which have received growing attention through time, especially in the number of sites requiring authorisation (Figure 3).

UAS and balloons received different treatments in the 1990s. While the use of UAS and model aircraft was restricted in many sites, the use of balloons was mostly subjected to authorisation. Since the 2000s, for both aircraft types, there has been a tendency to increase the number of sites requiring authorisation and a decreasing number of new sites banning the use of these aircrafts (Figure 3).

The published information on aviation restrictions over

and around natural protected areas is still scarce, and

## most of the published research is focused on noise disturbance in National Parks to tourists (Tal, 2001; Miller, 2008; Iglesias-Merchan et al., 2015). The effects of aircraft noise in wildlife have been extensively documented (e.g. Shannon et al., 2016; Mulero-Pázmány et al., 2017; Sierro et al., 2017), but the assessment of proposed aviation restrictions in protected areas due to wildlife protection has received less attention (see Alquezar & Macedo, 2019).

In the United States, there has been an intense debate on air tourism (Alexander, 1998; Rubenstein, 2000; Henry et al., 2000), as well as in other countries, such as New Zealand (Booth, 1999; Tal, 2004) and Australia (Hamilton, 2003; Ormsby et al., 2004). Subsequently, soundscapes have been considered as part of protected areas (Brown et al., 2011; Pijanowski et al., 2011) and taken into account when planning uses within a protected area (Miller, 2008; Brown, 2012). However, there are very large areas with no or little research on this aspect, which might be due to low noise levels in



Figure 3. Trend in the average minimum height AGL established to overflight protected areas and cumulative number of protected areas (sites) where aviation is subject to regulation, banning or subject to approval. Data are shown per aviation type and decade.

these areas in relation to countries with regulation (Buxton et al., 2017), or can be due to other causes, such as this kind of tourism is not established in these parts of the world (Belsoy et al., 2012). In Europe, a specific regulation has been created to reduce the impact of airport noise on human well-being (Regulation 598/2014). However, its effects on wildlife in natural areas and on wildlife in general have not been addressed. In Spain, the impact of aviation noise in natural areas has been addressed to some extent, but from a tourist perspective rather than evaluating its effects on wildlife (Iglesias-Merchant et al., 2014; 2015). However, European institutions are promoting the creation of regulations to limit the negative effects of aviation on wildlife in protected areas (e.g. the Commission Implementing Regulation (EU) 2020/469).

## **Overflight restrictions in Spain**

Spain has one of the densest airport networks in the world (Suau-Sánchez & Burghouwt, 2011). Tourists arriving by plane represent a crucial economic resource in many parts, especially on islands (Abeyratne, 1999; Balsalobre-Lorente et al., 2020), with many critical environmental implications (Alonso et al., 2014; Saenzde-Miera & Rosselló, 2014). Establishing overly strict conditions for air tourism might prevent or reduce it in many regions and would not have a cost-benefit from sociological and financial standpoints. For this reason, we consider that the steep increasing trend since the 1980s in both the number and area of sites under regulations was sustained in a period of satisfactory economic development that allowed an approach that is more restrictive on aeronautical economic activities and more respectful of biodiversity conservation. Since then, positive attitudes towards the environment have grown in Spain (Zeus & Reif, 1990; Sánchez et al., 2016). Therefore, this change might have eased this process of increasing regulation.

Analysing the restrictions per aircraft type, regulations are not very specific. In Spain, the current legislation regulating maximum flying heights establishes differences among UAS (120 m AGL), balloons, glider planes and motorised hang-gliders (300 m AGL), and there is a minimal flying height for planes and helicopters (150 or 300 m AGL, depending on the flying mode; EASA, 2018). Any restriction above those heights will be, inevitably, banned by Transport Department authorities. In this sense, protected area managers should take into account the different maximum flying heights per aircraft type before setting any operational restriction. As stated before, according to Spanish legislation these restrictions exclude most aircraft types. Therefore, management plans should consider the existence of other sectorial regulation to avoid excluding certain activities that might be compatible.

The increasing trend of establishing a previous authorisation for flight activities might be a solution in many protected areas. Since the 2000s, the number of protected areas that have established this requirement has increased for almost every aircraft type, with balloons being the only exception. Defining a priori conditions for flying over the most critical places would be a solution for protected areas with a low to moderate number of operations, and there might be different aspects of the authorisation which can complicate the technical validation of these specific permits of overflight (flight paths, heights, etc.; Pinto et al., 2019). However, for larger protected areas with intense aircraft use, the authorisation process can exceed the management capacity in certain cases. In these cases, establishing global flight regulations such as those proposed in this study might be a good solution if they can be put into force.

### A framework for future coexistence

Our experience has been very fruitful in this regard, with a willingness by all parties involved to achieve compatibility of the existing aviation activities and the conservation of biodiversity. The proposed general criteria should be extended to each protected area taking into account its particular characteristics and contexts. In this sense, the proposals should also take into account the existence of airports, aerodromes, bases and other existing aviation elements or established activities, as the ability of many species to get used to these activities is relatively high (González et al., 2006). Designing flight corridors or other options to concentrate disturbances might be a useful solution (Tittler et al., 2012).

Protected areas have great importance for the conservation and maintenance of biodiversity, as well as for human well-being, so as far as possible they should be protected from the impacts of aviation activity (Margalida, 2016; Moreno-Opo & Margalida, 2017). Current aviation regulations are almost exclusively focused on issues of wildlife–aircraft collision and noise impacts on humans, thus laws and their implementation relative to wildlife conservation are far from adequate (Alquezar & Macedo, 2019). Here, we show how it is possible to involve the different institutions in order to achieve a regulation that allows coexistence between aviation activities and wildlife conservation in protected areas.

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#### RESUMEN

La aviación produce una serie de efectos sobre la vida silvestre que deben tenerse en cuenta, especialmente en los espacios naturales. Las regulaciones y limitaciones al sobrevuelo de aeronaves en áreas naturales pueden reducir los impactos y promover la conservación de la biodiversidad. En España, se ha realizado un esfuerzo coordinado entre las diferentes administraciones para mejorar la regulación de la aviación en áreas protegidas. Analizamos la evolución de la normativa operativa que se encuentra legalmente establecida en las áreas protegidas de España y exponemos el nuevo marco establecido para proponer nuevas normativas para la aviación en áreas protegidas. Ha habido un incremento en el área bajo regulación desde la década de 1980, con un estancamiento desde la década de 2010. De igual manera, el crecimiento del número de sitios con nuevas regulaciones se ha ralentizado desde la década de 1990 debido a que la regulación en áreas protegidas se ha abordado progresivamente y la necesidad de regulaciones en nuevos sitios ha disminuido. Sin embargo, el número de áreas sujetas a autorización para volar se ha incrementado desde la década de 2000. La altura mínima promedio de sobrevuelo establecida para las áreas protegidas ha aumentado en las últimas dos décadas. Con base en evidencia científica, hemos propuesto varios criterios generales sobre alturas y distancias en áreas protegidas que permiten la coexistencia entre la aviación y la fauna silvestre. Tras ser ampliamente debatido, conseguimos que las diferentes administraciones públicas implicadas se comprometieran a incluir estos criterios generales en sus reglamentos. Consideramos nuestra experiencia totalmente exportable a otros países.

#### RÉSUMÉ

L'aviation peut avoir des impacts sur la faune et la flore qui doivent être pris en compte, notamment dans les zones naturelles. La limitation du survol des aéronefs dans les zones naturelles peut réduire les impacts et promouvoir la conservation de la biodiversité. En Espagne, un effort coordonné a été fait par les différentes administrations pour améliorer la réglementation de l'aviation dans les zones protégées. Nous analysons la tendance des réglementations opérationnelles qui ont été légalement établies dans les zones protégées en Espagne et décrivons un cadre nouvellement établi pour proposer de nouvelles réglementations pour l'aviation dans les zones protégées. On observe une augmentation de la superficie réglementée à partir des années 1980, pour atteindre un plateau à partir des années 2010. De même, la croissance du nombre de sites faisant l'objet d'une nouvelle réglementation a ralenti à partir des années 1990, car la réglementation dans les zones protégées a été progressivement traitée et le besoin de réglementation dans les nouveaux sites a diminué. En revanche, le nombre de sites soumis à une autorisation de survol a augmenté à partir des années 2000. La hauteur minimale moyenne établie pour le survol des zones protégées a augmenté au cours des deux dernières décennies. Sur la base des preuves disponibles, nous proposons des critères généraux sur les hauteurs et les distances dans les zones protégées qui permettent la coexistence entre l'aviation et la faune sauvage. Après consultation des groupes concernés, nous avons obtenu que les différentes administrations publiques impliquées s'engagent à inclure ces critères généraux dans leur réglementation. Notre expérience peut tout à fait s'appliquer à d'autres pays.