



**Acoustics'08
Paris**
June 29-July 4, 2008

www.acoustics08-paris.org

euronoise

Research into the improvement of the management of helicopter noise in the UK

David Waddington^a, Paul Kendrick^a, Geoff Kerry^a, Matthew Muirhead^b and
Ray Browne^b

^aAcoustics Research Centre, School of Computing, Science & Engineering, University of
Salford, M5 4WT Salford, UK

^bQinetiQ Ltd, Cody Technology Park, Ively Road, GU14 0LX Farnborough, UK
d.c.waddington@salford.ac.uk

Helicopter noise has a negative impact on the quality of life for many people. Affected populations are not just those living close to heliports, but include those exposed to noise from helicopters used by emergency services, the military, and commercial companies. One problem identified in the UK is that it is often difficult to complain about helicopter noise, since it is unclear which organization is responsible for dealing with the complaint. Consequently, the Department for Environment, Food and Rural Affairs (Defra, UK) has commissioned research to summarize the following:

- i. the nature and extent of the concern about helicopter noise in the UK
- ii. rules and regulations governing operations
- iii. existing procedures for handling complaints

This stage of the project will produce a detailed report into the improvement of the management of helicopter noise. Also to be produced is a short non-technical guide including the means of redress for perceived disturbance. This paper reports on the findings of this project.

1 Introduction

This research project was proposed by Defra with the objective of improving the management of noise from helicopter operations. This was due to a perceived lack of information in connection with helicopter noise, and in particular, with regard to whom complaints should be addressed. Clarification was also required on remediation and mitigation. Current perceptions were supported by the recent London Assembly Environment Committee report, "London in a Spin – a review of helicopter noise October 2006". That report states that there is anecdotal evidence of a growing concern amongst members of the public about helicopter noise. The Department for Transport (DfT) is currently working with the Civil Aviation Authority (CAA) and National Air Traffic Services (NATS) in response to the key recommendations. This work for Defra, which also looks at procedures abroad, addresses many of the questions raised in the London Assembly report although the scope of this study is UK wide.

2 Nature of the concern about helicopter noise

Surveys suggest some people tend to be concerned about helicopter operations and the noise they create for a number of reasons. The main issues identified in this report are summarized as follows:

- 1) The subjective response to aircraft noise is often described in terms of community 'annoyance' and studies have indicated that helicopters can be 10-15dB 'more annoying' than other aircraft [1].
- 2) Sound levels alone do not account for annoyance trends in communities. People are also concerned about other aspects of the operations and the noise acts as a trigger for these concerns. Examples include concerns about safety, perceived intrusion of the helicopter into one's personal living space, and negative opinions towards the purpose of the flight [2].
- 3) Research (primarily concerned with fixed wing aircraft) has shown that noise adversely affects classroom learning. It has been shown that low achieving students are the most adversely affected [3].
- 4) High aircraft (fixed wing) noise levels can awaken people, but the likelihood of the average person having

their sleep noticeably disturbed due to an individual aircraft noise event is relatively low [3]. However, sleep disturbance from helicopter operations may differ considerably due to its unique modes of flight such as hovering and low flying.

- 5) A recent study has shown that for every 10dB increase in night-time noise level for aircraft (L_{night} 2300 – 0700), the risk of hypertension is increased by about 14% [4].

3 Helicopter operations in the UK

Helicopter routing is generally designed to assist Air Traffic Control and to maintain separation from fixed wing aircraft. In general, helicopter routes are designed to fly over open spaces wherever possible. Types of civilian operations include:

- 1) Flights that take place during major sporting events (e.g. Goodwood Revival, British Grand Prix, Royal Ascot) and other major events such as the Farnborough air show.
- 2) Traffic surveillance.
- 3) Transporting heavy loads into inaccessible places (e.g. National Parks).
- 4) Pleasure flights.
- 5) Charter.
- 6) Transfers between airports / commercial premises.
- 7) Private owners.
- 8) Pipe line / power line surveying.
- 9) Scheduled services (e.g. Penzance to Isles of Scilly).
- 10) Servicing oil fields (e.g. Aberdeen).
- 12) Corporate flights.
- 13) Press / Aerial photography.

Helicopter noise generation differs from fixed wing propeller driven aircraft because the main rotor and tail rotor operate close to the horizontal plane and vertical plane, respectively, with axes of rotation normal to the flight direction. Whilst for propeller driven aircraft the axis of the propeller is aligned to the direction of travel, and the noise from each propeller generally has symmetry about this axis. Such axial symmetry does not exist for helicopter rotor blade noise sources. For this reason very few of the helicopter noise sources are similar to that of its fixed wing counterparts [5].

The choice of rotor blade tip speed and to a lesser extent blade tip shape, is important because it controls the intensity and character of the impulsive noise generated by a helicopter. This applies to both the main and tail rotors. The largest non-military user of helicopters in the UK provides transportation for the oil and gas industry. The

majority of helicopters used by the Police and by the Air Ambulance Service are the quietest types available.

Examination of the data indicates a steady increase in the number of civilian helicopters operating in the UK from 2002. These currently number 1,393 [6]. There has been a particular increase in the number of smaller piston engine craft and this increase appears to be due to the recent popularity of the Robinson R22 and R44 helicopter.

4 Extent of the concern about helicopter noise in the UK

The CAA reports that there were 370 noise complaints resulting from helicopter operations in the UK in 2007, 80 of which were regarding helicopter operations over London [7]. However, this is not a complete list as complaints about military helicopter use and complaints directed at operators and local authorities are not included.

The London Assembly Environment Committee 'London in a Spin' report states that "anecdotal evidence from the public has indicated a growing concern with helicopter noise" [8]. The authors comment "there is no comprehensive database of helicopter movements across London, so it is impossible to tell the extent to which this noise nuisance has increased".

Anecdotal evidence reveals 'pockets' of complaints arising around areas such as busy heliports, aerodromes and some RAF bases. RAF Shawbury reports receiving 313 noise complaints in 2007. The Chartered Institute for Environmental Health (CIEH) conducts an annual survey of environmental health departments but has only recently (in the past two years) started to record helicopter noise complaints. On average, for those two years, helicopter complaints make up about 5% of the overall number of noise complaints received from all transport; all transport being fixed-wing aircraft, motorbikes, cars and commercial vehicles (e.g. lorries, vans buses etc) [9].

5 Industry and stake holder view

On the 6th Feb 2008 an Institute of Acoustics meeting was held at the University of Salford entitled "The improvement of the management of helicopter noise". One of the aims of the meeting was to try to collect information by engaging major stakeholders in structured discussion. One of the results of the debate was that it appears the ratio of helicopter movements to number of complaints received is generally very small for most operations. A repeated view was that the scale of the problem of helicopter noise could not be estimated without the central logging of complaints. It was suggested that there is a need for a more "holistic" approach, and national statistics for helicopter noise complaints are required before an "informed debate".

An important point raised was the need to be cautious in using complaint statistics as a measure of the problem. While many complaints are from repeat complainers, not everyone that is disturbed complains. Furthermore, with relatively few numbers of complaints received about helicopter noise, a statistically meaningful result is difficult to derive.

Another suggestion to estimate the scale of the problem involved carrying out a national public survey. A point raised was that "canvassing opinion may raise the profile of the problem and aggravate it". However, social survey techniques exist to avoid this problem.

A generally common view from delegates was that the question of whether or not helicopter noise is a "problem" still needs to be determined; there does not seem to be enough evidence at present to answer this question. Recorded views included: "Although there is an argument that it may not be (a problem) now, I feel it certainly has the potential to become one" and "perhaps the question should not be 'is there a serious noise problem in the UK?' but rather 'Are we facing increased opposition to the development of helicopter bases and operations, and if so, what are we going to do about it?'"

General consensus among stakeholders was that there is not a significant helicopter noise problem throughout the UK. However, problems do exist and these are centered on helicopter infrastructure such as heliports and aerodromes.

6 Noise indices and measurement methods

In assessing the environmental impact of noise on individuals and communities, an objective descriptor with a well-defined relationship with community annoyance is required. Annoyance is complex and different individuals and communities react differently to different noise sources. A large number of indices have been developed for various applications. As this may lead to confusion and misinterpretation of data, a number of researchers have tried to move towards a standardized method of assessing aircraft noise [10] but have met with little success "because of the variability and unpredictability of reaction the impact of noise has always been difficult to quantify. As a result there is no single measure of the impact on the community of noise" [11].

In the UK, NNI was used after the government's Wilson committee report from 1963 until 1990, when the 1984 Aircraft Noise Index Study (ANIS) led to the LAeq being adopted as the UK aircraft noise index. The 16-hour LAeq and nighttime LAeq are used in planning legislation to determine whether planning application can be granted. Often noise levels are predicted to determine whether planning applications will be granted. As a result of the Environmental Noise Directive (END) (2002/49/EC), noise maps have been produced to identify noise climate and help develop action plans to manage noise levels. These maps show noise contours where each contour represents an average noise level. Lden is the 24-hr Leq calculated for an annual period, but with a 5 dB weighting for evening and a 10 dB weighting for night. Directive 2002/49/EC requires EU Member States to produce noise maps using the Lden noise metric, although helicopters are not currently included. The Lden is not an informative parameter for the depiction of helicopter noise, since helicopter noise arises from individual flights as opposed to the average of a large number of flights.

7 Existing dose response relationships

A dose-response relationship is a function that is designed to predict the relationship between an objective physical measure such as sound level, to a subjective response such as annoyance. The Aircraft Noise Index Study (ANIS), published by the CAA in 1984, aimed to accurately measure human responses to aircraft noise, and to find the dose-response relationship that best describes this subjective response. The result of ANIS was a dose-response relationship where the percentage of people who found the aircraft noise unacceptable increases from around 15% at 57dB LAeq roughly in a straight line to around 75% at 69dB LAeq. No equivalent study has been performed specifically for helicopters [12].

8 Subjective responses to helicopter noise

Most community response measures to acoustic stimuli are based on A-weighted sound pressure levels averaged over a long period of time. However, when dealing with only a small number of acoustic events, e.g. seven helicopter flights over a sixteen-hour period, the acoustic events have little bearing on the resulting measure. The United States FAA report [3] states the current measures are deficient for helicopters in terms of not only the number of events, but also in how the subjective effect is measured. In particular, low frequencies and the impulsive nature of sound are not accounted for in current metrics. The FAA acknowledges this problem in its 2004 report to the United States Congress but continues to use the Day-Night sound level (DNL) as there is no verified alternative.

In addition to these problems with measurement indices, studies have found that current objective metrics are not representative of annoyance, and that attitudes to the helicopter operations are a contributing factor. The term 'virtual noise' is used to describe non-acoustic factors such as fear of crashes and other negative views of the helicopter operations [2].

9 Rules and regulations in Europe

The Joint Aviation Authorities (JAA) is an associated body of the European Civil Aviation Conference (ECAC) representing the civil aviation regulatory authorities of a number of European States who have agreed to co-operate in developing and implementing common safety regulatory standards and procedures. This co-operation is intended to provide high and consistent standards of safety and a "level playing field" for competition in Europe. Much emphasis is also placed on harmonizing the JAA regulations with those of the United States' FAA [17].

The European Aviation Safety Agency (EASA) was set up to promote the highest common standards of safety and environmental protection in civil aviation. It is intended to be the centerpiece of a new cost-efficient regulatory system in Europe and a reliable partner for equivalent authorities throughout the world. As EASA develops the aviation

regulatory environment, it will change some of the existing CAA processes and procedures [18].

EASA became operational on 28 September 2003 and it will be fully functional in 2008. It is an independent legislative body under European law, accountable to the Member States and the European Union institutions. EASA itself is not an International Civil Aviation Organization (ICAO) signatory because it does not constitute a State; however, it works closely with ICAO and the Federal Aviation Administration (FAA) with the aim of harmonizing standards and promoting best aviation practice worldwide [19].

The creation of EASA has had a significant impact upon UK Registered aircraft. EASA has assumed responsibility for the type-certification and continued airworthiness of a large number of UK registered aircraft [19]. During the next few years, it is intended that the agency will extend its responsibility to aircraft operations, crew licensing and the certification of non-Member State airlines.

10 Rules and regulations in the USA

The Federal Aviation Administration (FAA) regulates operations in United States airspace. The regulations are called the Federal Aviation Regulations (FAR) and are part of the Code of Federal Regulations (CFR – title 14). Federal Aviation Regulation section 91.119 [20] states that aircraft must maintain a minimum distance of 1,000 ft above the highest obstacle and a horizontal radius of at least 2,000 ft from another aircraft.

In other than congested areas, aircraft are required to maintain an altitude of at least 500 feet above the surface over open water or sparsely populated areas. Over open water or sparsely populated areas, aircraft may operate at less than 500 feet above the surface provided that they do not fly closer than 500 feet to any person, vessel, vehicle, or structure. Helicopters may be operated at less than these minimum altitudes provided that they are conducted without hazard to persons or property on the surface [20].

11 Means of redress for any perceived disturbance caused

Often establishing communication and dialogue with helicopter operators can produce a positive outcome and an explanation of the purpose and nature of the operation that caused the disturbance can be satisfactory. Consultative committees have been found to be particularly helpful in raising issues with operators and ensuring operators are aware of their environmental impact. In addition, making the operator aware of problems caused can often result in changes to operational procedures to help alleviate the public disturbance.

The CAA acts as a focal point for receiving environmental complaints about aircraft in the UK. However, the CAA has no legal power to prevent aviation solely on environmental grounds. Unless there is clear evidence of a breach of the Air Navigation Order, the CAA will advise the complainant to contact the operator directly.

The outcome of a complaint to the CAA will either be;

- 1) a referral to ARED (Aviation Regulation Enforcement Department) in the event of a breach of the ANO, or
- 2) advise contact of local planning authority in the case of a change of land use or to advise contact the aircraft operator directly.

The Directorate of Airspace Policy Environmental Information Sheet - Number 1 entitled 'Aircraft Noise' [21], comments that the CAA is tasked with ensuring that procedures at airports meet required standards of safety but the operators are responsible for the environmental impact of their aircraft operations. The CAA is expected to, "strike a balance between the needs of the airport/aircraft operators and the needs of the local community". As a result, the CAA encourages noise complaints to be made directly to the airport operator.

Problems related to noise generated on the ground at aerodromes, other than in association with the normal operation of aircraft, should be referred to the Local Authority. However, local authorities have a statutory bar on action against aviation noise sources under the Environmental (EPA) noise legislation.

12 Management of Environmental Noise from Helicopters

Consultative committees to enable dialogue between residents, councils and the heliport operator have helped to improve understanding and acceptance by the public. The dialogue should be extended to include developers so that homes are created with sufficient sound insulation. A fast and sincere response is important in keeping complainants from becoming repeat complainers. The failure to act on complaints is one of the largest causes of dissatisfaction and resentment amongst the public.

The CAA provides a focal point for receiving and responding to aircraft related environmental complaints from the public. However, the CAA currently has no legal power to prevent aviation solely on environmental grounds. An independent review is considering greater power for the CAA on environmental matters. The CAA encourages noise complaints to be made directly to the airport operator. Problems related to noise generated on the ground at aerodromes, other than in association with the normal operation of aircraft, should be referred to the Local Authority. MOD complaints are usually dealt with through the base's community liaison officer.

BHAB codes of practice aim to increase helicopter pilots and operators awareness of environmental noise issues. Although pilots are aware of noise issues, factors such as safety are considered to be more important. The Joint Aviation Authorities (JAA) represents the civil aviation regulatory authorities of a number of European States who have agreed to co-operate in developing and implementing common safety regulatory standards and procedures. Regulations governing the management of helicopter noise in Australia and the United States are broadly in line with those in Europe, in part due to the harmonization work of the Joint Aviation Authorities (JAA).

Two significant European projects address noise from helicopters these are FRIENDCOPTER and the "Clean

Sky" JTI. Both aim to produce a significant reduction in the noise generated by helicopters. The Environmental Noise Directive requires noise maps and action plans on a five-year cycle. Helicopters are not excluded, though rudimentary noise mapping of helicopter noise is currently restricted to major airports. However, the accuracy of these strategic noise maps relating to helicopter noise is limited by the lack of sufficient source data and validation of noise prediction models in this context.

13 Conclusions

13.1 Nature and extent of the concern about helicopters noise in the UK

- 1) Problems due to helicopter noise are centered on helicopter infrastructure such as holding areas, heliports and aerodromes.
- 2) Compared with fixed-wing aircraft, the ratio of movements to the number of complaints received is generally small for most helicopter operations.
- 3) The consensus among stakeholders is that there is increasing opposition to the development of heliports on the grounds of noise disturbance.
- 4) There is no comprehensive database of helicopter movements in the UK. Consequently, it is impossible to determine the extent to which noise nuisance is a growing concern.
- 5) Precise determination of the scale of public concern about helicopter noise would require a careful social study.

13.2 Procedures in place for handling helicopter noise complaints

- 1) The CAA acts as a focal point for receiving and responding to aircraft-related environmental complaints from the public. Complaints regarding military flights should be addressed to the base's community liaison officer.
- 2) The CAA encourages noise complaints to be made directly to the airport operator.
- 3) Problems related to noise generated on the ground at aerodromes should be referred to the Local Authority.
- 4) Consultative committees to enable dialogue between residents, councils and heliport operators have been shown to improve understanding and acceptance by the public.
- 5) The failure to act on complaints is one of the largest causes of dissatisfaction and resentment amongst the public.

13.3 Rules and regulations governing helicopter operations

- 1) BHAB codes of practice aim to persuade helicopter pilots and operators to take more notice of environmental noise issues.
- 2) Helicopter noise certification does not address community annoyance caused by helicopter noise. A

gradual reduction in the certification levels will not address public acceptability.

3) In England, the current land use planning guidance (PPG24) states that noisy and noise sensitive land uses should be kept apart. PPG24 provides advice to assist with the consideration of new residential development near existing sources of aircraft noise, but the guidance states that it should be used with caution where there is existing helicopter noise. PPG24 contains limited planning guidance on the noise impact of new heliports.

13.4 Dose response relationships

1) Helicopters can be 10-15dB more annoying than fixed-winged aircraft. However, helicopter noise levels alone do not account for annoyance trends in communities.

2) There is no single satisfactory noise index for the measurement or prediction of the impact of noise on the community.

3) Noise maps displaying Lden are unsuitable to be used for the prediction of subjective response of communities to helicopter noise.

Acknowledgments

This paper presents work performed on behalf of Defra by the University of Salford and QinetiQ Ltd. However, we would like to thank the large number of people that assisted in this research and in the preparation of the report. The authors are grateful to Defra for funding the work leading to this paper.

References

[1] A. Pike, "Institute of Acoustics: Helicopter Noise – What is important from a Community Perspective?," in *The Improvement of the Management of Helicopter Noise*, University of Salford, 2008.

[2] J. W. Leverton and A. C. Pike, "Helicopter noise - What is Important from a Community Perspective," in *American Helicopter Society 63rd Annual forum* Virginia Beach, VA, 2007.

[3] "Report to Congress: Nonmilitary Helicopter Urban Noise Study": Federal Aviation Administration, 2004.

[4] L. Jarup, W. Babisch, D. Houthuijs, G. Pershagen, K. Katsouyanni, E. Cadum, M.-L. Dudley, P. Savigny, I. Seiffert, W. Swart, O. Breugelmans, G. Bluhm, J. Selander, Alexandros Haralabidis, K. Dimakopoulou, P. Sourtzi, M. Velonakis, and F. Vigna-Taglianti, "Hypertension and Exposure to Noise Near Airports: the HYENA Study," *Environmental Health Perspectives*, vol. 116, pp. 329-333, March 2008.

[5] M. J. T. Smith, *Aircraft noise*: Cambridge University Press, 1989.

[6] BHAB, "The British Helicopter Advisory Board Hand Book," 2008 - <http://www.bhab.org/>

[7] J. Walker, "Institute of Acoustics meeting : Management of environmental noise from helicopters –

Civil Aviation Authority," in *The Improvement of the Management of Helicopter Noise*, University of Salford, 2008.

[8] "London in a spin - a review of helicopter noise," London Assembly - Environment Committee October 2006.

[9] "Personal communication with Kim Willis, Research Project Officer, CIEH," 2008.

[10] D. Smeatham, G. Kerry, and P. D. Wheeler, "The Management of Light Aircraft & Microlight Noise at Military Airfields," Department of Applied Acoustics, University of Salford 1995.

[11] M. J. T. Smith, "Do we really need 57 ways of rating aircraft noise?," *Internoise 90*, 1990, pp. 467-470

[12] P. Brooker, J. B. Critchley, D. J. Monkman, and C. Richmond, "United Kingdom Aircraft Noise Index Study: Main Report," Jan 1985.

[13] "About CASA": <http://www.casa.gov.au/corporat/index.htm>. Last viewed 25th March 2008.

[14] CASA, "Aviation history: First certificates for Airservices" 2003: <http://casa.gov.au/media/2003/03-05-01.htm>. Last viewed 25th March 2008.

[15] CASA, "Aviation safety explained": www.casa.gov.au/publicinfo/casarole.htm. Last viewed 25th March 2008.

[16] "Visual flight rules guide - Version 2," CASA, 2007.

[17] "Introduction to JAA": <http://www.jaa.nl/introduction/introduction.html>. Last viewed 25th March 2008.

[18] "Civil Aviation Authority : EASA - European Aviation Safety Agency": <http://www.caa.co.uk/default.aspx?catid=620>. Last viewed 25th March 2008.

[19] "CAA:On overview of the regulations with which all of the aviation industry must comply": <http://www.caa.co.uk/default.aspx?catid=1404&pagetype=90>. Last viewed 25th March 2008.

[20] "FAA Federal Aviation Regulations 91.119."

[21] "Aircraft Noise," The Directorate of Airspace Policy.

[22] "Meeting Minutes with Christopher Forrest of PremiAir," 2007.