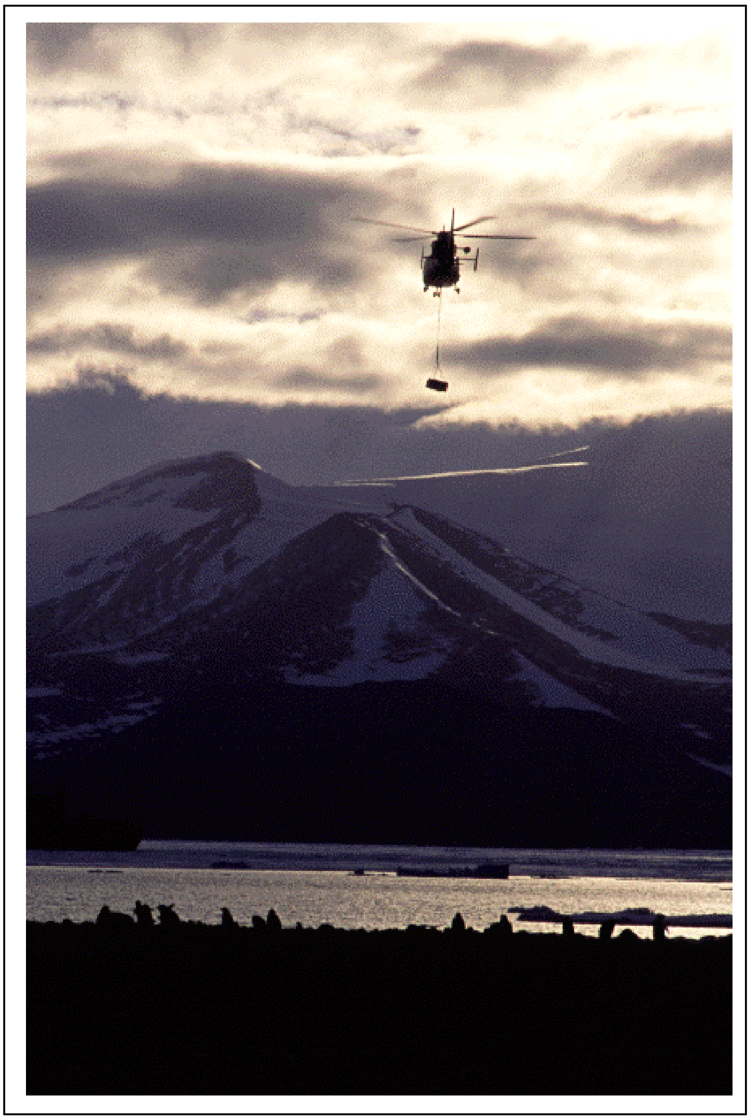
Guidelines for the operation of aircraft near concentrations of birds



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Adapted from a paper originally prepared for the

Project Steering Committee

UK Antarctic Protected Areas Management Plan Review

and for consideration by the

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Preamble

This paper was originally prepared by Dr C. Harris (*Environmental Research and Assessment*, Cambridge) for the UK Antarctic Protected Areas Project Steering Committee as part of the UK's review of management plans for Antarctic protected areas. The UK Project Steering Committee asked that the paper be forwarded to the Bird Biology Subgroup of SCAR for further consideration at SCAR 2000, Tokyo, which offered the following response:

The SCAR Bird Biology Subgroup:

1. Recognised the need for clear and consistent interim guidelines for the operation of aircraft near concentrations of birds in Antarctica;
2. Recommended adoption of interim guidelines (see Table 4), and that these should be adopted in the entire Antarctic Treaty Area and on sub-Antarctic islands throughout the Southern Ocean, not just within Antarctic protected areas;
3. Recommended that there should not be any reduction of more stringent guidelines where they exist;
4. Suggested that where existing guidelines were less stringent, these should be reviewed in light of those recommended in Table 4;
5. Acknowledged that at some localities aircraft may need to operate within the recommended guidelines;
6. Noted there is insufficient knowledge of the impacts of aircraft on Southern Ocean seabirds, and that the recommended interim guidelines may require revision in light of the results of further studies.

The original paper has been edited following the comments of the SCAR Bird Biology Subgroup: in particular Table 4 has been revised in accordance with their recommendations. The present paper was submitted to the CEP IV, St Petersburg, Russia (June 2001), in abbreviated form by the United Kingdom to provide information on this important issue, with a view to assisting towards the future development of practical interim guidelines for consistent application in places where aircraft are operating in close proximity to birds in Antarctica.

1.0 Introduction

Aircraft provide vital support to modern Antarctic operations and their use is widespread and increasing. Concerns have been expressed over the potential effects of aircraft on Antarctic wildlife (Rounsevell and Binns 1991, Cooper *et al* 1994). In the course of revising management plans for Antarctic Specially Protected Areas to meet the requirements of Annex V, it has become apparent that there is a lack of clear and consistent guidance available for the operation of aircraft close to concentrations of birds. There is a practical need for clear policies on the use of aircraft to be written into the management plans for Antarctic Specially Protected Areas. As far as possible, it would seem desirable that guidelines adopted are consistent across all protected areas, especially where the same species are under special protection: confusion could arise if different heights were adopted at different breeding locations.

It is also important that any guidelines adopted are simple enough to be understood and applied easily by a wide range of operators from numerous countries, working in many different parts of the Antarctic. And yet the problem itself has potential to be very complex: for example, factors that might contribute to decisions on the 'appropriate' distance an aircraft may approach concentrations of birds are wide-ranging and include the variable interaction among the aircraft (the source), the birds (the receptor), the ambient environment (spatial context) and the timing, duration and frequency of exposure (temporal context) (Table 1).

In view of the potential complexity, there is a need for guidelines that are simple enough to be applied practically, and yet are robust enough to provide comprehensive and effective protection under a wide range of scenarios involving a combination of the possible factors shown in Table 1.

2.0 A brief history of guidelines

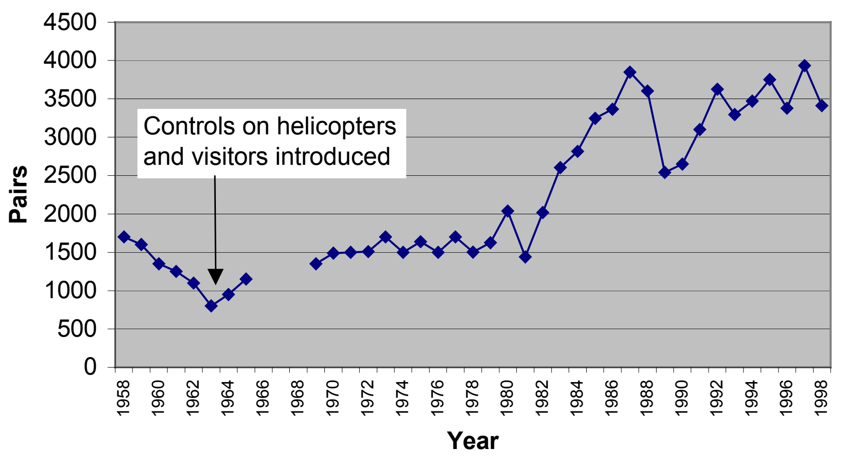
A variety of guidelines for the operation of aircraft near to bird populations have been adopted for use within Antarctica. The first formal recommendations are found in the Agreed Measures on the Conservation of Flora and Fauna, adopted by Antarctic Treaty Parties in 1964: Article VII prohibited activities likely to cause harmful interference with native fauna, such as 'flying helicopters or other aircraft in a manner which would unnecessarily disturb bird and seal concentrations, or landing close to such concentrations (e.g. within 200 m)' (Heap 1994).

Table 1. Possible factors influencing the interaction of aircraft and birds

Source (aircraft properties)	Spatial and Temporal Context	Receptor (birds)
Type – fixed wing, rotor, non-motorised	Terrestrial, marine, or air environment	Species – sensitivity, behaviour
Engines/rotors – number, type, size	Surface – boulder, sand/gravel, ice, snow, water	Age and stage of breeding cycle
Shape/colour – size, wingspan, orientation	Terrain – rugged, slope, open, enclosed	Numbers and density
Activity - takeoff, landing, cruising, turning	Weather – fine, cloud, rain, snow, wind	Exposure history – 'experience'
Direction – approach, departure, oblique	Visibility – terrain, weather, time of day	Species abundance / rarity
Speed – air, ground	Predators – proximity, numbers, disposition	
Proximity – vertical, horizontal	Humans – proximity, numbers, activities	
Noise – type and magnitude function of above	Exposure – timing, duration, frequency	

Around this time, formal steps were taken in 1963 by the New Zealand and United States national programmes to restrict helicopter operations and other disturbance to birds by visitors at Cape Royds, Ross Island, where numbers of breeding Adélie Penguins (*Pygoscelis adeliae*) had declined to almost half of their pre-1956 levels (Stonehouse 1963, 1965; Thompson 1977). Overflight of the colony was prohibited, and restrictions were placed on the number of visitors and their activities. The helicopter landing site was moved from within 70 m to about 250 m from the colony. Following these measures, the colony increased to its former size (Figure 1), although strict cause and effect has not been established: increases since 1968 have been in accordance with trends apparent in colonies throughout the region (Taylor *et al* 1990, Martin 1991).

Figure 1. Adelie penguin *Pygoscelis adeliae* population Cape Royds 1958-98



In 1992 management plans were adopted by the Antarctic Treaty Parties for SPA No. 1 (Taylor Rookery, Mac. Robertson Land), SPA No. 2 (Rookery Islands, Mac. Robertson Land), and SPA No. 3 (Ardery and Odbert Islands, Budd Coast), with various restrictions on helicopter access. At SPA No. 1 helicopters may not land within 500 m of the penguin colony and overflight is completely prohibited (although, according to the management plan map, the designated helicopter landing site is 350 m from the traditional breeding area of the emperor penguins (*Aptenodytes forsteri*)). At SPAs No. 2 and No. 3, where the islands are small, it is permissible to land a helicopter within 500 m of the colony 'only if it can be demonstrated that disturbance will be minimal'. At these sites overflight is allowed only for essential scientific purposes, for which it is prohibited to fly below altitudes of 500 m. At SPA No. 3 there is the additional restriction that overflight must be no less than a horizontal distance of 500 metres from the colonies. The site identified as most suitable for helicopter landing on Ardery Island is less than 100 m from one of the breeding petrel colonies. At this site it is stipulated that helicopter movements should be kept to a minimum during the breeding season of 1 November to 1 April.

The Antarctic Flight Information Manual (AFIM 1995) contains a number of restrictions on aircraft operations close to bird colonies. The most comprehensive and stringent guidelines are those issued by Australia, which note that it is an offence under Australian law to "fly an aircraft in such a manner as to disturb a concentration of birds (more than 20) or seals (more than 10) or by flying, landing or operating a vehicle within 200 m of such concentrations" (AFIM 1995: AUS29). More recently, Australia has issued guidelines governing the use of helicopters (Australian Antarctic Division 2000), discouraging pilots from overflying wildlife at any altitude, and more specifically prohibiting, without a permit, operation of single-engine helicopters within 2500 ft (about 750 m) or a twin-engine helicopter within 5000 ft (about 1500 m) horizontally or vertically of wildlife. Exceptions are allowed in an emergency or when it is reasonably necessary to do so during the conduct of ship-shore operations for the purpose of establishing, supplying or maintaining a station.

At Dumont D'Urville station (France), flights are prohibited below 250 m AMSL over bird colonies (AFIM 1995: DUMONT-3), while at Signy Station (United Kingdom) it is required that all 'low' overflights be avoided owing to the presence of bird and seal colonies. The UK has not defined the level that is considered 'low'. Most countries do not provide specific guidance on flying heights over bird colonies in the AFIM, suggesting instead that pilots 'contact the control tower' for information on any local flying restrictions. It is probable that pilots would receive a wide range of recommendations from control tower personnel.

Antarctic Treaty Parties adopted in 1997 a revised management plan for Beaufort Island (SPA No. 5), the site of breeding colonies of 46,000 pairs of Adélie penguins and approximately 1300 emperor penguins. The management plan prohibits overflight of bird breeding areas lower than 750 m unless it is required for essential scientific or management purposes, when transient overflight (such as may be required for aerial census of the colonies) may be allowed down to a minimum altitude of 300 m. The areas within which these restrictions apply are shown on maps and extend at a minimum 250 m in horizontal distance from the borders of the breeding sites.

In 1999 the Antarctic Treaty Parties adopted a management plan for Svarthamaren (SSSI No. 23), a site protected because it contains the largest sea-bird colony on the Antarctic continent and a large proportion of the world population of Antarctic petrels (*Thalassoica antarctica*). All overflight and landings within the protected area are prohibited, although the recommended helicopter landing site – while outside of the protected area boundary – lies within 350 m of the northeastern breeding area of the birds.

In the sub-Antarctic islands, a variety of guidelines for aircraft operations have been adopted. In New Zealand's sub-Antarctic islands, helicopter use is controlled by permits specifying landing sites, overflight and approach paths etc. on a case by case basis (NZ Dept of Conservation, pers. comm. 2001). Specifically, helicopter landings are prohibited except when necessary for scientific, emergency or other approved purposes provided all precautions are taken against endangering or unduly disturbing plant and animal life. As a condition of all landings, low level flying within 200 m (assumed both horizontally and vertically) of any bird or seal colony during the breeding season is given as a mimimum (DoC 1998). At Australia's Heard Island, helicopter operations are to be undertaken such as to minimise impacts on wildlife concentrations and in accordance with the guidelines in force by the Australian Antarctic Division as described in the AFIM above (Australian Antarctic Division 1995b). Similar requirements are outlined in the management plan for the Macquarie Island Nature Reserve (Australian Department of Parks, Wildlife and Heritage 1991).

In relation to South African air operations on sub-Antarctic islands, Cooper *et al* (1994) recommended that fixed-wing aircraft should normally avoid overflight below 1000 m vertically and 5000 m horizontally, reducing to 500 m vertically for passes required for essential air drops, and reducing further to an unspecified height for the drop itself. It was also recommended that helicopters avoid flying 'at low altitudes in the vicinity of, or approach or land within 500 m of king penguin breeding colonies' (Cooper *et al* 1994: 281). On Gough Island, helicopter landings may only be undertaken for scientific or management purposes and must not cause 'excessive disturbance to seals and birds', and landings are not allowed within 200 m of breeding seals and penguins (Cooper and Ryan 1993: 29). Helicopter overflights of seals and breeding penguins are to be 'kept to a minimum', although specific distance restrictions are not given.

In the recently published environmental management plan for South Georgia (McIntosh and Walton 2000), guidance on helicopter use stipulates that overflight and landing are prohibited at all king penguin (*Aptenodytes patagonicus*) colonies at all times; at all albatross colonies during the breeding season; beaches with elephant seals during the breeding season; and certain designated fur seal breeding beaches. Moreover, it is planned to develop specific flight path and approach procedures for regularly visited sites. Flight routes along the coast are set at a minimum horizontal distance of 1000 m, and at a minimum altitude of 1000 m above land in those areas where overflight is permitted (McIntosh and Walton 2000: 63). These interim recommendations will be reviewed in the light of research being undertaken by BAS scientists on the effects of helicopter overflight on wildlife (Stone, pers. comm. 2000).

The Protocol on Environmental Protection to the Antarctic Treaty, on the other hand, does not provide specific guidelines on minimum distances for the operation of aircraft near concentrations of birds and seals in Antarctica. Instead, the Protocol stipulates that flying or landing helicopters or other aircraft in a manner that disturbs concentrations of birds and seals constitutes 'harmful interference', which is prohibited except in accordance with a permit. What constitutes 'disturbance' or a 'concentration' are not defined. Table 2 summarises examples of guidelines for aircraft use in the Antarctic and sub-Antarctic environment.

Table 2. Examples of guidelines adopted for aircraft operations in the Antarctic / sub-Antarctic

Year	Party	Location	Aircraft type	Number of engines	Minimum distance (m)	
					Vertical	Horizontal
1963	US / NZ	Cape Royds	Helicopter	ns	ns	250
1964	Treaty Parties	Antarctica – Agreed Measures	Helicopter	ns	200	200
1983	New Zealand	Campbell Island	Helicopter	ns	200	200
1984	New Zealand	Snares Island	Helicopter	ns	op[1]	ns
1991	Treaty Parties	Antarctica – Environmental Protocol	All	All	ns	ns
1992	Treaty Parties	Taylor Rookery (SPA-1)	Helicopter	ns	op	500 (350[2])
1992	Treaty Parties	Rookery Islands (SPA-2)	Helicopter	ns	500	<500[3]
1992	Treaty Parties	Ardery and Odbert Islands (SPA-3)	Helicopter	ns	500	<500[4]
1993	South Africa	Gough Island	Helicopter	ns	ns	200[5]
1994	South Africa	Sub-Antarctic Islands	Fixed-wing	All	1000[6]	5000
1995	Australia (AFIM)	Antarctica	All	All	200	200
1995	Australia (AFIM)	Antarctica (additional guidelines)	Helicopter	1	500	1000
			Helicopter	2	1000	1000
1995	Australia	Heard Island and	Helicopter	1	500	1000
		Macquarie Island	Helicopter	2	1000	1000
1995	France (AFIM)	Dumont D'Urville	All	All	250	ns
1995	UK (AFIM)	Signy Island	All	All	'low' op	ns
1997	Treaty Parties	Beaufort Island (SPA-5)	Helicopter	1 or 2	750	250
			Fixed-wing	All	300	250
1999	Treaty Parties	Svarthamaren (SSSI-23)	Helicopter	1 or 2	op	350[7]
2000	GSGSSI	South Georgia	Helicopter	1 or 2	op[8]	1000
2000	Australia	Antarctica (recent published guidelines)	Helicopter	1	750	750
			Helicopter	2	1500	1500

ns - not specified
op - overflight prohibited
GSGSSI - Government of South Georgia and South Sandwich Islands
1. Prohibited within the Oct-Apr breeding season, otherwise allowed for essential purposes.
2. Distance of recommended landing site from traditional breeding area of emperor penguins.
3. Provided it can be demonstrated disturbance will be minimal.
4. Can land less than 500 m from colony provided it can be demonstrated disturbance will be minimal, but all overflight must be no less than a horizontal distance of 500 m from the colony. Preferred landing site on Ardery Island <100 m from petrel colony.
5. Refers to landings, with distances for overflight not specified.
6. Reducing to 500 m vertical and 2000 m horizontal for air drop passes, and less for the drop itself (recommendations by Cooper *et al* 1994; applying at Marion Island).
7. Recommended helicopter landing site 350 m from bird breeding areas.
8. Prohibited over all king penguin breeding colonies at all times; specific other areas prohibited at breeding times; 1000 m vertical limit over areas where overflight is permitted.

3.0 Experimental evidence on the effects of aircraft operations on Antarctic birds

A number of studies have been conducted on the effects of aircraft on birds (e.g. Fjeld *et al* 1988, Delaney *et al* 1999). However, there have been few experimental studies to measure the effects of aircraft operations on Antarctic birds. Studies published thus far have mainly reported observations on only a few species: Adélie penguins (e.g. Stonehouse 1963, 1965; Ainley 1983, Culik *et al* 1990, Taylor *et al* 1990, Wilson *et al* 1991, Giese 1996), king penguins (Rounsevell and Binns 1991, Cooper *et al* 1994) and emperor penguins (Kooyman and Mullins 1990, Regel and Pütz 1997, Giese and Riddle 1999) (Table 3). A number of studies have examined the effects of human disturbance on Antarctic penguins (e.g. Wilson *et al* 1990, Nimon and Stonehouse 1995, Giese 1996, Fraser and Patterson 1997, Nimon 1997), although only a few have made controlled observations or measurements of the effects of aircraft (Sladen and Leresche 1970, Taylor *et al* 1990, Culik *et al* 1990, Giese and Riddle 1999). Several studies have considered human impact on other species, such as skuas (Hemmings 1990, Young 1990) and southern giant petrels (*Macronectes giganteus*) (Chupin 1997), although these were not specifically concerned with the effects of aircraft. The latter study attributed poor breeding performance among southern giant petrels on Fildes Peninsula, King George Island, to low aircraft overflight (in some instances less than 50 m), helicopter activity and other direct human disturbance on the ground.

Table 3. Distance at which 'disturbance' was apparent in Antarctic birds in experimental flight observations

Study	**Aircraft**			**Species**	**Distance at which 'disturbance' was observed**					
	H or FW	**Type**	**Eng-ines**		**Vertical (m)**			**Horizontal (m)**		
				Reaction of birds[1]>>	Minor	Mod	Major	Minor	Mod	Major
Sladen *et al* 1970	H	LH-34	2	*Pygoscelis adeliae*	914	457	300	-	-	183
Taylor *et al* 1990	H	ns	ns	*Pygoscelis adeliae*	610	-	-	-	-	-
Culik *et al* 1990[2]	H	Sea King	2	*Pygoscelis adeliae*	-	-	50	<1500	-	200-1500[4]
Kooyman *et al* 1990	FW	Hercules C-130	4	*Pygoscelis adeliae*	1500	-	-	-	-	-
Wilson *et al* 1991	H	Super Puma AS332	2	*Pygoscelis adeliae*	50 m constant[3]			600-1500[4]	ns	400-1250[4]
Wilson *et al* 1991	FW	Twin Otter DHC-6	2	*Pygoscelis adeliae*	80 m constant[3]			1000-600[4]	500	-
Wilson *et al* 1991	FW	Hercules C-130	4	*Pygoscelis adeliae*	50 m constant[3]			1100-2500[4]	500-2300	350
Cooper *et al* 1994	H	Super Puma AS332	2	*Apt. patagonicus*	ns			500	-	-
Cooper *et al* 1994	FW	Hercules C-130	4	*Apt. patagonicus*	100-300 m [3]			ns	ns	< 500
Cooper *et al* 1994	FW	Hercules C-130	4	*Diomedea exulans*	'low level', presume overhead			No visible reaction		
Giese *et al* 1999	H	Sikorsky S-76	2	*Apt. forsteri*	1000 m constant[3]			Reactions mostly minor; distances ns		

H - Helicopter **FW** - Fixed wing **ns** - not specified

1. The strengths of reaction recorded in the different studies are not strictly comparable, and my classification into 'Minor', 'Moderate' and 'Major' is intended simply as a general guide. *Minor* is taken as the distance at which birds first showed visible reactions (e.g. neck craning, flipper-flapping), *Moderate* where a large proportion of birds (30%-70%) began more vigorous displays or moving away, while *Major* is where more than 70% of birds began moving away, or many began running or panicked. For specific explanations of the reactions of the birds the reader is referred to the papers referenced.
2. Culik *et al*'s (1990) study focused on measuring heart rates, not behaviour with distance, and thus only their behavioural observations are included here.
3. The reaction of the birds was noted for constant flying heights and with varying horizontal distance: the reactions are thus presented only in the columns for horizontal distance.
4. Where two distances are given, the first refers to the approach distance at which disturbance was observed to cause this reaction, while the second figure is that at which the reaction ceased as the aircraft receded.

Sladen and Leresche (1970) observed the behaviour of Adélie penguins in response to an LH-34 US Navy helicopter operating at various altitudes with a ground speed of around 40 knots at Cape Crozier, Ross Island. In summary, they observed that when this aircraft operated at altitudes of less than about 500 m over the birds, disturbance to their behaviour became 'moderate' or 'great', which was classified on the basis of the percentage of birds exhibiting reactions such as displays or moving from their territories. These authors recommended that a minimum altitude for overflight of Adélie penguins by a helicopter should be 610 m (2000 ft), although they acknowledged that even at this altitude there was still some disturbance evident. They also noted that overflights using fixed-wing aircraft (such as a Twin Otter) at the same elevation generally caused less disturbance, although controlled observations of fixed-wing aircraft were not undertaken.

Taylor *et al* (1990) also made observations of the effects of aircraft passes over Adélie penguin colonies during preparations for a regular aerial census programme of colonies in the Ross Sea region. These authors reported findings similar to Sladen and Leresche (1970) in relation to helicopter movements. They also observed overpasses by C-130 Hercules fixed-wing aircraft, and did not detect visible disturbance when flying over 300 m (1000 ft) above the birds, although it should be noted that these observations were themselves made from the aircraft.

Culik *et al* (1990) reported that helicopters approaching within 300-400 m of an Adélie penguin colony caused noticeable behavioural responses among the birds, such as running away from the aircraft. Late in the breeding season helicopter activity as distant as 1500 m caused 'panic runs' and 'escape reactions', even in areas where the birds were never approached by the helicopter less than 400 m (p. 181 [the authors say 'more than 400 m', but it is assumed 'less' was meant]). In addition to behavioural observations, heart-rate levels in a number of Adélie penguins were monitored. When subjected to a helicopter operating within 20 m, the heart rate of one adult bird was elevated to the highest recorded, although, perhaps because of the small sample size, there was no statistical difference between the rate observed and those measured when incubating adult birds stood without any aircraft stimulus, as they might a few times an hour (Culik *et al* 1990: 197). Moreover, techniques employed in this study involved human handling of the birds which were later used in the observation, leading some to criticise results (Nimon and Stonehouse 1995, Nimon 1997).

Giese and Riddle (1999) observed creching emperor penguin chicks when they were exposed to two overflights by a Sikorsky S-76 twin-engine helicopter at 1000 m. They reported that all chicks became more vigilant when approached by the helicopter (with an air speed 60 knots), and almost 70% either walked or ran, generally less than 10 m, toward other chicks. Most displayed flipper-flapping, which was seldom displayed in the absence of the aircraft. Although the effects were found to be transitory, the authors suggested the results supported the "introduction of a more conservative guideline of 1500 m (5000 ft) minimum overflight altitude for helicopter operations around breeding localities of this species" (p. 366).

None of the studies that have specifically addressed the problem of effects of aircraft on Antarctic birds may be considered comprehensive, and all may be criticised for methodological weaknesses. Only a limited range of species, aircraft, environments and conditions have been studied: there remains much work to be done before experimental results can provide reliable guidance on the levels at which aircraft may generally operate without significantly disturbing bird populations. There also remains the question of what might be considered 'significant' disturbance. Scientists at the British Antarctic Survey have initiated several studies specifically to address some of the data deficiencies (Boyd and Trathan; Stone, Shears and Walton; pers comms 2000), although results are not yet available. However, taking the findings in the above published studies, Table 3 attempts to summarise some of the observations that have been made of the distance at which 'disturbance' was apparent in the species under study when subjected to various types of pressure from the presence of aircraft.

4.0 The need for interim guidelines

Aircraft are operating, and will continue to operate, in proximity to concentrations of birds in Antarctica, and pilots should be provided with the benefit of access to clear and consistent guidelines on acceptable – perhaps precautionary – approaches to the operation of their aircraft in these contexts. Pilots are usually keen to minimise the environmental impacts of their operations, although often lack the expert guidance needed to enable them to achieve this. However, guidelines also need to be practical, as over-precautionary approaches have the potential to be unreasonably restrictive on air operations, and could severely curtail flight operations or compromise margins of safety.

Although there is a need for more empirical data on which to base definitive environmental guidelines for air operations in the Antarctic, there remains an immediate need for practical procedures that can be followed. In relation to protected areas, management plans are presently being drafted for numerous sites in order to comply with the requirements of Annex V to the Protocol. Specific procedures for access, including air access, to the sites need to be written into these plans. Policies are being developed on minimum flying distances, both horizontally and vertically, and in relation to selection of suitable landing sites. There has emerged a confusing plethora of recommended distances, some of which differ for the same species at different sites. It would be helpful if there was an agreed set of interim guidelines available that could be used in the formulation of these management plans, ensuring consistency and enabling more practical implementation by pilots in the field.

Development of practical air access policies for these sites cannot wait until the research required is completed. Discussions with a number of Antarctic ornithologists throughout the process of preparing draft management plans has revealed, at least so far, that a general consensus on minimum distances may be possible for the purpose of interim guidelines. Table 4 presents a summary of suggested minimum heights and distances developed after consultation with ornithologists reviewing a number of draft protected area management plans, and revised following comments on an earlier version considered by the SCAR Bird Biology Subgroup at SCAR 2000 (Tokyo). The mimima suggested in Table 4 are now consistent with the recommendations of the SCAR Bird Biology Subgroup.

In the absence of a clear scientific basis to do so, the guidance makes no attempt to differentiate between species, although perhaps this is needed, and possible, for the few species for which data are available. Questions arise over what distances would be appropriate for sites where there are multi-species assemblages. As recommended minimums, however, there would be nothing to prevent countries and/or operators from adopting more rigorous standards should they so choose.

Table 4. Suggested minimum horizontal and vertical distances for aircraft operations close to concentrations of birds in Antarctica.

Aircraft type	Number of engines	Minimum distance (m)			
		Vertical (above ground)[1]		Horizontal	
		Feet	Metres	*Feet*	Metres
Helicopter	1	*2461*	750	*2461*	750
Helicopter	2	*3281*	1000	*3281*	1000
Fixed-wing	1 or 2	*1476*	450	*1476*	450
Fixed-wing	4	*3281*	1000	*3281*	1000

1. Heights are above the ground on which birds are present, not mean sea level.

Recognising that there may occasionally be specific circumstances in which it might actually be desirable to exceed guidelines – which by their nature are for general application – it would be useful if specific circumstances in which exceptions could be considered were defined (e.g. for research itself examining the effects of aircraft on birds, or perhaps for essential aerial surveys). There may also be the need to provide more guidance on what constitutes 'disturbance' and a 'concentration' in the context of Antarctic birds. In relation to 'disturbance', for example, it could be useful to distinguish between immediate behavioural responses and longer-term demographic impacts.

The SCAR Bird Biology Subgroup supported the need for a set of interim guidelines on air operations close to concentrations of birds. Table 4 reflects their recommendations and is intended as a basis for further discussion. It is recognised that some might consider the distances proposed as too stringent or complex, while others might equally consider them too weak. It is hoped that the Antarctic Treaty Parties might find this paper helpful towards eventual agreement of a set of practical interim guidelines for aircraft operations close to concentrations of birds in Antarctica. Should a practical set of interim guidelines be developed for application in areas where there are concentrations of birds, these may prove helpful as a model for further development and adjustment for application to other forms of wildlife in Antarctica.

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