CITY LANDFILL AND BIRDS' FLYING HAZARD AT THE PRESIDENTE PRUDENTE AIRPORT, SÃO PAULO STATE, BRAZIL

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ABSTRACT

Aircraft incidents caused by birds flying near airports are increasingly frequent. Hence, a two-year qualitative study was carried out, seeking to understand the risk posed by urban solid trash and waste landfills as well as the pertinent legislation, in a Case Study based on the close proximity between a City Landfill and a State Airport at Presidente Prudente, in Western São Paulo State, Brazil. This two-year study concluded that both the chosen technology and the Landfill's location threaten landing and take-off operations at this Airport, pointing to poor management of urban solid trash & waste as well as an illegal pertinent legislation.

Keywords: Fauna Hazard, Municipal Landfill, Urban Solid Waste, Flight Safety, Bird Strike.

1. INTRODUCTION

Brazilian urban demographic concentration keeps increasing, generally with no adequate previous planning. This and an ever-increasing demand for consumption goods increase the USW problem (Urban Solid Waste), luring birds to these landfills. Cultural factors, social dimensions, overall development, consumption habits and patterns, population income are all directly related to USW generation in a given society striving to survive (Bidone and Povinelli, 1999). Thus, the national development level interferes in society and, consequently, in its USW generation.

According to the Brazilian Institute of Geography and Statistics (IBGE, 2010), over half of Brazil's cities to this day still simply dump their garbage and waste in open-air landfills, which offer ideal bird-attracting conditions, given their plentiful supply of food and waste.

When dumped into landfills, with no adequate planning or infrastructure, USWs attract birds, including buzzards and other birds of prey – *vide* Oliveira (2012): "Some activities may become bird-attracting foci, especially for buzzards. E.g.: sewage treatment plants, leathering, slaughter-houses, landfills, and some cattle-raising operations". Presidente Prudente's solid wastes are dumped into a large landfill, with strong bird-luring potential.

In addition to social, environmental and sanitation problems, this inadequate USW procedure also compromises the safety of aircrafts taking-off and landing, as birds and planes share the same air space. This issue has been gaining importance in the air sector, especially as more modern aircrafts fly ever faster, propelled by more complex powerful engines. Flying birds have caused material damages to aircrafts, in incidents and even accidents, jeopardizing human lives in the air and on the ground (Allan, 2000).

A highly-publicized case in point was an US Airways aircraft successfully and skillfully brought down by its pilot and co-pilot safely on the Hudson River's water, in New York City, following its collision with a flock of birds, in January 2009 (Honorato, 2010). Albeit successful, with no victims, this watering procedure (forced landing on water) could well have been a major air tragedy.

This present Paper uses the inductive method, since observation (necessary in this method) is a major tool to ensure a better resolution of this problem. Indeed, observation is essential to a complex description of the region wherein Presidente Prudente's State Airport is located (Prodanov, 2013).

Our real-context observation of this phenomenon occurred between November 2013 and March 2014, with weekly land visits to the City Landfill and flying over the area, to ensure better knowledge of the existing hazard.

2. FLIGHT SAFETY

Flight safety is a sine-qua-non pre-condition in aviation. It means reducing and managing, as much as possible, the hazard of personal injuries and material damages (OACI, 2013). Therefore, investment is a must, as air accidents can cost human lives (not to mention staggeringly high financial costs).

Aviation in Brazil has been growing by leaps and bounds (demand has more than tripled in the past decade). Average air transportation growth since 2003 has more than tripled Brazilian GDP (Gross Domestic Product) and outpaced the national population growth by a ratio over 14 / 1 (Brasil, 2014a). For such an amazing sky-high growth to be considered an air-sector advancement, flight safety has to be maintained and constant improvements must occur.

Passively accepting the threat of an air Bird Strike collision (airplane and birds) is extremely irresponsible. Environmental damages could be huge (due to fire, fuel leaks). So too could be the direct and indirect financial impacts, including human lives lost in the air and on the ground. Any effective prevention needs the involvement of all air-system personnel, whether they work in planning, management, operation, support, or otherwise. Laws (and their rigid enforcement) are necessary to regulate and control animal-attracting spots near airports.

3. LEGISLATION

Seeking to reduce the Bird Strike hazard has become ever-more important in worldwide aviation - *vide* reports of the Federal Aviation Administration (FAA) and of the Organização da Aviação Civil Internacional / International Civil Aviation Organization (OACI).

As a member of the latter, Brazil is hard pressed to adopt legislation to regulate soil use and the bird hazard in airport vicinities. For instance, a two-organ interaction stands out, namely, CENIPA and CONAMA, respectively, Centro de Investigação e Prevenção de Acidentes Aeronáuticos (Center to Investigate and Prevent Air Accidents) and Conselho Nacional do Meio Ambiente (National Environmental Council).

Brazil signed the Civil Aviation International Convention (Decree nº 24.713, August 27, 1946). This Convention's item 9.5 ("Bird Strike Reduction") determines, in its norm 9.5.4, that the competent authority sees to it that no bird-attracting garbage, trash or waste source whatsoever be installed near airports (Brasil, 1946). However, this Decree, as an international recommendation, says nothing about which authority is competent for such care. It thus remains an open question whether such authority lies with ANAC (Civil Aviation National Agency), the afore-mentioned CENIPA or with airport managers, such as INFRAERO (Brazilian Airport Infrastructure Company), DAESP (São Paulo State Airways Department), or the concession holders.

Brazil's current Air Code (1986) says that properties near airports and airfields as well as facilities and installations ancillary to air navigation are subject to constraints, limitations and whatever else might hinder or interfere with aircraft operations - *vide* Bird Strike Hazard, in its article 43, Law nº 7.565; December 19, 1986 (Brasil, 1986). But as with OACI's recommendation, no organ is named as responsible for imposing such constraints and limitations.

One year later, paragraph One, article 46 in Ordnance nº 1.141/GM5 (December 08, 1987) coins the Portuguese-language expression "*Implantação de Natureza Perigosa*" (Implementation of a Dangerous/Perilous Nature) and determines its prohibition in Approach and Transition Areas at Airports and Heliports. In this concept, it spells out that "slaughter-houses, garbage and trash outlets, bird-attracting farming crops" are part of such constraints and limitations (Brasil, 1987). Regrettably, however, this Ordnance was later replaced by Ordnance 256/CG5 May 13, 2011), which made no clear mention whatsoever of "bird-attracting activities". It only dealt generally with this type of Implementation of a Dangerous Nature.

Up to 2014, the best Brazilian legislative progress to reduce Bird Strike Hazard was perhaps the staking out of an Airport Security Area (*ASA*), in CONAMA's resolution 004, article I, caput I and II (October 09, 1995). A 13-and-20km radius was established for VFR (visual flight rules) Airports and IFR (instrument flight rules Airports), respectively. Article 2 of this same CONAMA Resolution banned the implementation of activities deemed to be "bird-attracting foci", on the grounds that these foci were of a hazardous nature (Conama, 1995).

However, on May 30, 2014 Brazil's Daily Official Gazette published the approval of Resolution nº 320, Section 1, Page 5, entitled "Managing Fauna Hazards in Public Airfields and Airports", a.k.a. (also known as) Brazilian Civil Aviation Regulation (*RBAC 164*) (Brasil, 2014b). This Resolution was created due to the fact that the various existing legislations were not able to set requirements applicable to operators in public Brazilian airports, so that these operators could manage bird-posed hazards to air operations.

RBAC 164's approval filled a regulatory gap of requirements applicable to monitoring and fiscalizing Brazilian public airports, as regards Fauna Hazard Management. This Norm seeks to demand the incorporation of operational and maintenance operations of airports by their managers, in order to mitigate animal hazards in general, bird risks among them.

On the other hand, as regards solid waste, Law nº 12.305 (August 02, 2010) created *PNRS* (National Solid Waste Policy). Regulated by Decree nº 7.404 (December 2010), PNRS instituted parameters to manage solid waste, striving to reduce the problem in simple, clear and straightforward fashion (Brasil, 2012).

Actions tended to mobilize and integrate the entire Brazilian society to solve its socio-environmental issues. Administrative responsibilities were decentralized and actions were shared, as policies were rendered adequate to match the final disposal of solid waste to the needs of Brazilian States, Municipalities and the Nation's Capital - within an overall integrated management plan, in cooperation with all sectors in society.

The state of São Paulo also has USW legislation, such as Law nº 12.300 (March 2006), which set guidelines for a State Solid Waste Policy (*PERS*). Its Article 2 mandates an integrated USW management in all cities in the state (São Paulo, 2006). Likewise, a Project to Support Municipal Solid Waste Management-GIREM was created by Decree nº 57.817 (February 28, 2012). Its overall coordination is under the São Paulo State Environmental Office through its CPLA - Environmental Planning Coordination (São Paulo, 2012).

State policy aims at reducing USW amount, eliminating landfills and avoiding / preventing environmental problems. It also seeks to promote social integration through the inclusion of people who pick reusable and recyclable materials. These persons would join selective urban collection programs, thus fostering inter-city cooperation and developing city management programs.

Cities also have normative planning instruments: a Master Plan, a Multi-year Plan, Budgeting Guideline Legislation, an Annual Budget, Soil Use and Occupation Legislation, Soil Partition Legislation, thereby articulating a local development process through baseline guidelines to draw up plans, projects and public works (Takenaka, 2006). Hence, cities do have practical tools to develop actions within the necessary resources and available funds, as per their known needs, and analyzing the full city public policy cycle - thus meeting growing municipal social demands.

In an overwhelming majority of the cities, USW management is not yet carried out by a specific organ, even though state legislation mandates that cities in the state of São Paulo organize their own solid-waste-management legislation and projects.

Both federal and state policies encourage the idea of inter-city consortia to jointly manage USW in a given region's municipalities. The cities would organize selective collecting and coops of reusable and recyclable pickers, drawing up a plan for the whole County-like Micro-region, in full cooperation among the three levels of government and civil society.

PNRS dictates that cities must sort out dry from wet waste. They next would progressively separate the dry waste into specific types. Thus, city legislation would comply with legal specifications, such as pre-requirements for cities to be eligible for federal financial funds, financings, incentives in the areas of urban cleaning and solid waste disposal.

4. CASE STUDY: THE PRESIDENTE PRUDENTE STATE AIRPORT (STATE OF SÃO PAULO)

Presidente Prudente had a 2014 population of 220,599 inhabitants and its urbanization rate reached 98% (IBGE, 2000). It is the only mid-size city within a 150 km. radius in Far Western São Paulo state (Figure 1 herein), occupying 562,107 square kilometers (km²), 16,56 km² of which in its urban area. Its population ranks as 36th. in the state of São Paulo and 1st. in its Far Western county-like micro-region.

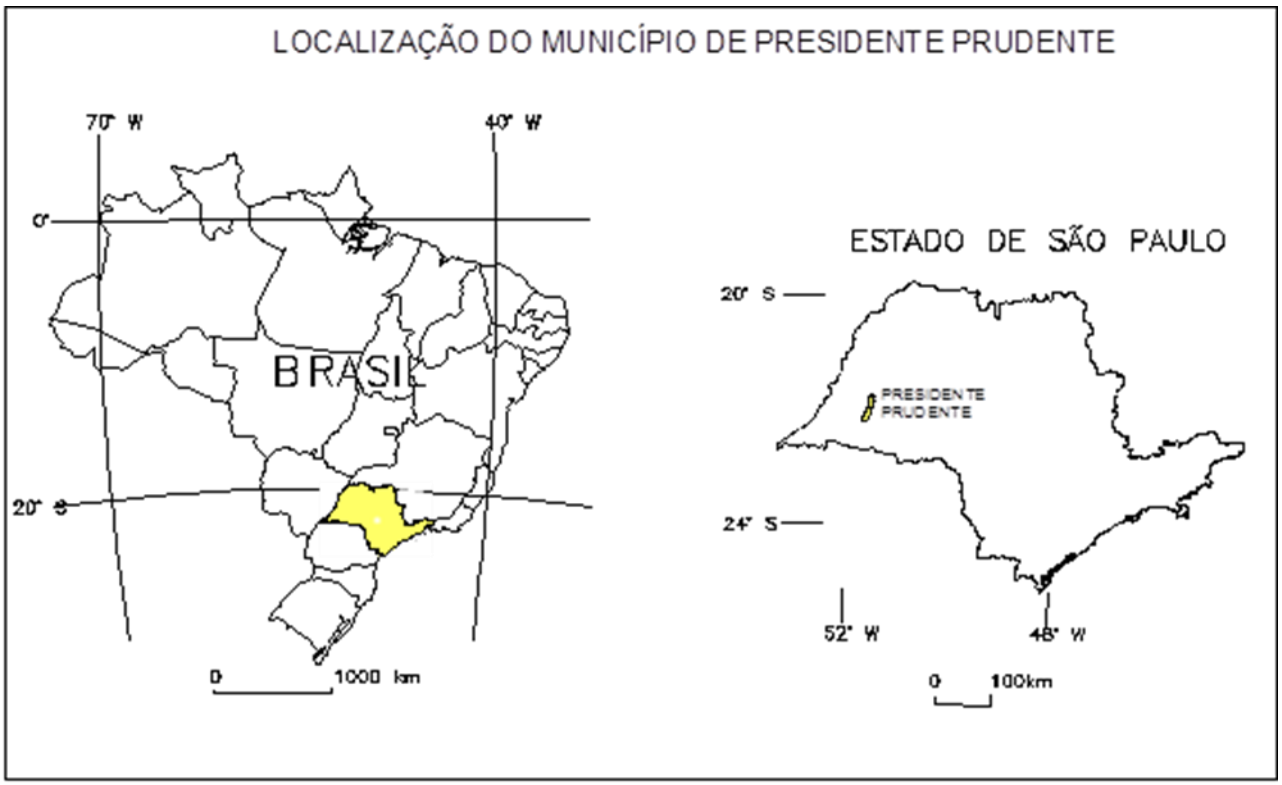

Figure 1: Presidente Prudente's location - São Paulo state (Geography and Cartography Institute, 2001)

Historically, the city disposed its solid waste beyond its urban grid, disregarding altogether factors such as wind direction, spring water source location, and proximity to residential areas - the more so since neighborhoods mostly housed low-income populations (Leal, 2002).

However, as urban expansion spread, many garbage disposal sites and their immediate surroundings were incorporated into new neighborhoods, as plaza locations (both squares & circles), soccer football fields, child daycare centers, schools, and so on. Some such locations are so poverty-plagued that they barely reach survival levels. Construction structures are woeful and underground waters are rampantly contaminated. The airport location and the hazards posed by its close proximity to these demographic spots were simply never taken into account.

No wonder then that Presidente Prudente now faces such serious urban solid-waste problems. They are collected and disposed of in a controlled landfill, near the city's Industrial District and very close (about 6 km. or less than 4 miles) from the city's State Airport.

According to DAESP (São Paulo State Airways Department), Presidente Prudente's airport operates in both VFR and IFR - respectively, Visual and Instrument flight rules (DAESP, 2014). Therefore, its *ASA* radius reaches 20 km (close to 12 miles).

Again according to *DAESP* (2014), this airport has only one asphalt-paved 2,100 m-long and 35 m-wide runway. (One meter is slightly over one yard). Both runway heads can be used to start take-offs, depending on the wind direction. The two runway heads are labeled "12" and "30", the former ("12") considered predominant by DAESP itself (Figure 2 herein).

Figure 2: Air Traffic Control System (adapted from Vismari, 2007)

Presidente Prudente's State Airport has one restaurant, one cafeteria, two car rental offices and facilities to operate both passenger transportation and air cargo hauling (DAESP, 2014). Two airlines currently operate in it, namely, "Azul Linhas Aéreas Brasileiras" and "Gol Linhas Aéreas". Each has three daily flights (six altogether every day by regular airlines).

These two regularly-scheduled-flights airlines use mid-size aircrafts in this airport, such as turbo-propeller ATR 42-500, ATR 42-500/600 operated by Azul Linhas Aéreas. Gol Linhas Aéreas operates turbo-fan models, such as Boeing 737-700.

Regular passenger transportation service at the airport is complemented by seven hangars offering general and executive aviation services (turb-propelled small jets and especially, piston-propelled aircrafts).

In addition to passenger transportation (Regular and General Aviation), the airport also is a base for teaching Private and Commercial Pilots as well as Flight Instructors, all offered by the traditional Presidente Prudente Airclub. São Paulo State Military Police's Eagle 16 ("Águia 16") is home-based at this Presidente Prudente State Airport, taking off and landing for its regular police operations in the entire region.

The airport further has its own Weather Station (Estação Meteorológica), runway signaling and taxiing guidance, rotation guiding lights, taxiing lights, runway obstacles lights, headway and parking patio lights, lighted windsock, radio ancillary services for instrument air navigation (NDB, VOR, DME), Control Tower, standard traffic circuit in both runway heads, homologated for instrument operation (IFR), which ensures a 20km-radius ASA (Airport Security Area) - close to 12 miles (DAESP 2014).

In this 20km ASA radius, no hazardous bird-attracting operations are allowed. Indeed, for any type of activity to be cleared, some previous airport safety procedures must be followed and fully complied with.

A previous survey of bird-attracting spots can be found in Hespanhol et al (2014). This survey attempts to make explicit and emphasizes the need and relevance of specific policies to manage urban solid waste now dumped in the city landfill.

Aircraft use of this "Adhemar de Barros" State Airport in Presidente Prudente dropped 12.13% in 2014 (*vide* DAESP). From January through August 2013, there were 11,511 take-offs and landings, while in the same time period

in 2014 there were 10,114 flights (Adhemar de Barros was a former São Paulo State Governor).

Despite this flight reduction, the number of passengers increased. The airport now ranks 3rd. in passenger boarding and un-boarding in the São Paulo hinterland airports (everywhere else but the state capital), behind respectively Ribeirão Preto and São José do Rio Preto only. According to DAESP, 266,123 passengers were flown in 2013, as compared to 289,124 in the previous year (2012) - see Table 1 herein.

Table 1 - Airport Passengers - São Paulo State (DAESP, 2014)

AIRPORT / CITY	PASSENGERS - 2012	PASSENGERS - 2013
Ribeirão Preto Airport	1.077.010	1.096.285
São José do Rio Preto Airport	770.569	758.513
Presidente Prudente Airport	**289.124**	**266.123**
Aeroporto de Araçatuba	177.516	164.981
Aeroporto de Bauru-Arealva	160.571	138.424
Aeroporto de Marília	92.437	75.747
Aeroporto de Sorocaba	77.776	50.244
Aeroporto Campo dos Amarais	43.856	47.395
Aeroporto de Bragança Paulista	28.194	37.510
Aeroporto de Araraquara	21.709	25.048
Aeroporto de Jundiaí	21.031	16.605
Aeroporto de Itanhaém	16.677	12.897
Aeroporto de Assis	6.503	6.408
Aeroporto de Ubatuba	5.548	5.422

Again according to DAESP, fewer passengers flew in 2012-2013 because of the flight type used. The airport administrator explained that landings and take-offs were reduced due to fewer executive aircraft operations. Even with fewer flights, aircrafts with more seats ensure the presence of more passengers.

Mid-size cities in the state make up sets of urban geographic grids, reflecting space interactions harking back to the configuration of logistics systems and airline infrastructure. They also converge to intensify air flow throughout the state, thus contributing to increase passenger circulation in the whole state (state capital and everywhere else). Mid-size cities are thus knots holding together geographic grids/networks, as they synthesize space interactions among territories and project forward a dynamics made possible by air transportation.

This Paper considered Presidente Prudente a mid-size typical average city in the state of São Paulo. A concept analyzed by Corrêa (2007) sees an average city as a peculiarity grounded on the assumption of a specific

combination of relations among its Size, Urban Functions and Intra-urban Space Organization.

As for regional air space movement, our analysis was based on the leading São Paulo cities of Araçatuba, Bauru, Marília, Presidente Prudente, Ribeirão Preto and São José do Rio Preto, all with DAESP-managed airports. These airports are hub-like knots holding together the hierarchy of urban network grids. They connect their own regions to the state capital metropolis, through the logistics strategy of the airlines operating routes in these six afore-mentioned cities.

5. DOCUMENT-BASED EVIDENCE OF HAZARDS

All pilots intending to fly must - in their planning - know the Notams in their route and adjust to them, if there are any. NOTAM is an acronym for "Notice to Airmen", called in Brazil's Portuguese language "aviso aos aviadores" (Warning to Aviators). NOTAMS are published by the air traffic control responsible for the area to be flown over, and must contain all information relevant to pilots - e.g.: observations or alterations in airport structure or in air spaces.

For DECEA (Air Space Control Department), NOTAM is a "warning regarding information related to the establishment, condition or modification of any air facility / premises, services, procedures or hazards, whose prompt (immediate) knowledge is indispensable to the crew and all personnel linked to the flight operations" (Brasil, 2014c). These Warnings bear in them their validity period, and can be Permanent (which is rare) or Temporary (more frequent).

In browsing through Presidente Prudente Airport's Notams, one finds the following message:

"Permanent Notam, valid since September 20, 2012 at 19:22 Z, indicates concentration of birds (Buzzards) in the aircraft traffic circuit and in the approach sector to both airport runways (12 and 30)." (Brasil, 2014d; bold letters are our own).

CENIPA (Center for Investigation and Prevention of Air Accidents) issues reports that also confirm bird presence at or near the airport. These reports are based on information supplied by persons involved in aviation. Contacts between aircraft and birds are broken down into three possibilities, namely: Sight, Collision, and Near-Miss. Such CENIPA reports record all three types of possibilities occurring at Presidente Prudente's State Airport (Brasil, 2014e).

6. EVIDENCES OBSERVED IN LOCO

Based on the nomenclature bestowed by Teixeira (2001), Urban Solid Wastes (USW) are associations of different solid waste types under city government's responsibility, contemplating a set of urban waste with compatible handling among them, excluding solid waste generated in industries, civil construction and by health services.

In some of our visits we observed in and around the airport the presence of mid-size birds, such as grass-seeking Vanellus chilensis, and larger black-head king buzzards (Coragyps atratus), albeit in small flocks (Sigrist, 2009).

Taking into account the municipal landfill's current status, it could be argued that Presidente Prudente has neither an Environmental City Policy nor any Solid Waste City Policy. However, the city makes use of municipal environmental legislation and, consequently, urban solid waste, based on its Organic Legislation and acted upon through its Master Plan. This Master Plan is mandated by city legislation and seeks to order and organize the development of city social functions and ensure the welfare and well-being of the city residents. This is all mandatory nationwide, since the promulgation of Brazil's 1988 new Federal Constitution, through its articles and provisions dealing with Urban Policy.

Takenaka (2008) explains that solid waste is managed by PRUDENCO (Companhia Prudentina de Desenvolvimento / City Development Company), a mixed-economy corporation. Since 2007, MPESP (Ministério Público do Estado de São Paulo / São Paulo State Attorney's Office) has been watching City Hall through PJMAPP (Promotoria de Justiça do Meio Ambiente de Presidente Prudente / Presidente Prudente's Public Attorney for the Environment), insisting on the adoption of new methods for the final destination / disposal of

Urban Solid Waste. Such waste is dumped daily in an area very close to the city's urban grid. This informal illegal landfill is very well named: Lixão ("big trash & garbage open-air area").

This lixão undergoes no soil preparation whatsoever (previous or otherwise), no drainage or water-proofing (impermeabilization) of any kind. It is just covered by layers of earth every single day. Takenaka (2008) says that animals still prowl in the area (pigs, horses, cows and others). This area is characterized as a "controlled landfill", meaning it has no license or permit issued by any environmental control organ. This lixão is located just six kilometers (less than four miles) from the Presidente Prudente State Airport's runway's mid-point.

Field visits showed the presence of mid-sized Vanelluschilensis as well as many flocks of larger black-head buzzards (Coragypsatratus) (Sigrist, 2009) throughout the whole Industrial District region (Figure 3 herein). These birds are found especially in areas above the landfill, looking like huge black clouds, whether seen on the ground or in flight. For security sake, flights over the region kept a safe distance from them, and there was intensive need of detours to avoid collisions.

Figure 3: Black-head buzzards in Presidente Prudente's Municipal Landfill

Figure 4 herein helps better understand both the Landfill's location and its 6-km-distance to the Airport.

Figure 4: Landfill and Airport Location (Google Earth, 2014)

The close proximity is thus made evident between Presidente Prudente's Airport and Landfill. The images / photos herein also show some city neighborhoods likely to be hit in case of an eventual air accident.

7. CONCLUSION

Several laws and decrees in Brazil address the issue of hazards posed by birds close to airports. Overall, this issue has been evolving positively and it should also be pointed out that there is enough federal and state legislation on responsibility for urban solid waste and for its proper destination.

Nevertheless, such existing legislation does not make explicit which organs are responsible for planning, monitoring and watching over (fiscalizing) these aspects of ASA (Airport Security Areas), even though RBAC 164 has been a major step forward.

As regards Urban Solid Waste (USW), the city government is clearly responsible for its correct handling and adequate destination, regardless of bird hazards or not (which could be, at best, further motivation to act).

During this Case Sudy, bird presence was confirmed in the airport region, a clear threat when flights are in visual rules (VFR). Detour maneuvering away from birds and bird flocks were constantly necessary, the closer the aircraft got to the landfill region.

Our Paper points to measures to mitigate bird-attracting foci (and, consequently, also Bird Hazards at the airport). One of the chief actions urgently needed is to turn the current open-air huge garbage dump into a controlled landfill. This engineering solution would trump other alternative solutions (such as open-air garbage dumping, which is Presidente Prudente's case), would benefit the population in general and would stand a better chance to do away with the threats and hazards object of this Paper.

An Animal Hazard Management Plan must be considered, in view of the large quantity of birds close to Presidente Prudente's State Airport, a fact acknowledged and proven by this Airport's NOTAM, by CENIPA's records and by recent academic studies.

New studies are suggested on the variation of bird numbers at different times of day and a possible correlation with the seasons of the year. Studies of hazards in IFR (instrument flight rules) are also relevant, as in IFR the aircraft pilot cannot detour away from birds because he/she has no visual contact outside the aircraft and the landfill location is near some IFR areas. These same studies would likewise be of great value to increased flight security and safety in other airports.

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