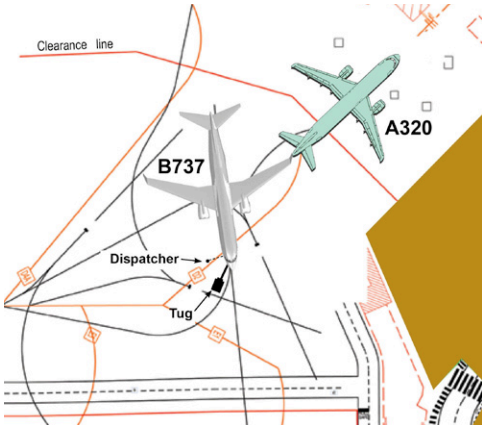
Australian Government
Australian Transport Safety Bureau

Aviation Occurrence Statistics

2004 to 2013



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Addendum

Page	Change	Date
111	Correction to recreational aviation incidents by occurrence type	17 Nov 14

Safety summary

Why have we done this report

Thousands of safety occurrences involving Australian-registered and foreign aircraft are reported to the ATSB every year by individuals and organisations in Australia's aviation industry, and by the public. The aim of the ATSB's statistical report series is to give information back to pilots, operators, regulators, and other aviation industry participants on what accidents and incidents have happened, how often they are happening, and what we can learn from them.

What the ATSB found

In 2013, there were 106 accidents, 221 serious incidents, and about 5,500 incidents reported to the ATSB involving Australian (VH– registered) aircraft. There were also 71 accidents, 33 serious incidents, and 137 incidents involving Australian recreational aircraft and a further 200 foreign-registered aircraft operating within Australia or its airspace were involved in reportable safety occurrences.

Over the past 9 years, recreational aeroplane, aerial agriculture and private/business/sport operations had the most accidents per hour flown, with more than 160 accidents per million hours flown. Gyrocopters (recreational aviation) had the highest fatal accident rate over this period, followed by recreational aeroplane and private/business operations.

Commercial air transport aircraft were involved in the majority of occurrences, and in 2013 the most common occurrences reported were wildlife strikes, weather affecting aircraft, and aircraft system problems. Most accidents and serious incidents involved reduced aircraft separation, engine malfunction, or runway excursions. The number of incidents reported by commercial air transport operators has increased in each of the last 10 years, reflecting more flights and greater awareness of the importance of reporting safety occurrences.

General aviation aircraft, such as aircraft conducting flying training, aerial work, or private/pleasure flying, were involved in over one-third of occurrences reported to the ATSB in 2013. Wildlife strikes, runway events and aircraft separation issues were the most common incidents reported. In comparison, most accidents and serious incidents involved terrain collisions, reduced aircraft separation, or a loss of aircraft control. There was a fall in general aviation accidents and fatalities in 2013 particularly in private, business and sport flying (which is where most accidents and fatalities in general aviation happen) and in aerial work.

Recreational aviation aircraft (non-VH registered) were also involved in fewer reported accidents in 2013, although the number of fatal accidents doubled. Most accidents and serious incidents involved terrain collisions and engine malfunctions.

Safety message

Aviation occurrence statistics provide a reminder to everyone involved in the operation of aircraft that accidents, incidents, and injuries happen more often than is widely believed. Some of the most frequent accident types are preventable, particularly in general aviation. Pilots and operators should use the misfortunes of others to help identify the safety risks in their operation that could lead to a similar accident or serious incident.

Timely and thorough reporting of safety incidents is paramount. The ATSB's capability to understand why accidents and incidents happen and to identify the major safety risks in different types of aviation operations is at its best when all aviation participants report all safety incidents. The information the ATSB provides helps everyone in the aviation industry to better manage their safety risk.

Contents

Context

Each year, the Australian Transport Safety Bureau (ATSB) receives accident and incident notifications from pilots, airline operators, air traffic control, maintenance personnel, aerodrome operators, emergency services authorities, and from the general public. The reporting of these aviation accidents and incidents, collectively termed occurrences, assists the ATSB in monitoring safety through its core functions of independent investigation and the analysis of data to identify emerging trends.

The types of occurrences that are required to be reported to the ATSB are detailed in the Transport Safety Investigation Regulations 2003. Depending on the seriousness of the event (in terms of the potential to cause injury or damage) and the category of operation, these occurrences are categorised as either immediately reportable matters (IRMs) or routine reportable matters (RRMs). To see the full list of IRMs and RRMs, visit the ATSB's website at www.atsb.gov.au/about_atsb/legislation.aspx.

Aviation occurrence statistics are updated and published annually by the ATSB, and can be subject to change pending the provision of new information to the ATSB. When using these statistics, it is important to remember that occurrence data is provided to the ATSB by responsible persons as defined in Part 2.5 of the Regulations. The ATSB accepts no liability for any loss or damage suffered by any person or corporation resulting from the use of these statistics.

NOTE: In this edition of Aviation occurrence statistics, there are generally less incidents shown than earlier editions due to a change of ATSB policy. Events involving operational non-compliance with air traffic control verbal or published instruction, airspace infringement, and breakdown of co-ordination between air navigation service providers, when they occur without any other occurrence event, have not been included as incidents in this edition. See Appendix A – Explanatory notes for more detail.

Activity data

The overall number of safety occurrences alone does not represent a complete picture of aviation safety. For meaningful comparisons to be made between different types of aircraft and the operations they perform, aviation occurrence statistics are often presented as a rate per million hours flown or per million departures.

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) collect and compile this activity data from reports submitted by airlines, and from other aircraft operators through the *General Aviation Activity Survey*.

Activity data used to calculate rates in this report can be found in Table 1 and Table 2. This data is rounded to the nearest thousand hours (or thousand departures) to present the size or magnitude of the data in more general terms. Specific activity data for movements of non-Australian (foreign) registered aircraft is limited, but is tabulated where available.

Departures

Aircraft departures are widely used as a measure of exposure, that is, the opportunity for an event to occur within a certain amount of flying activity. This report uses departure data for calculating accident and fatal accident rates for all air transport operation types and general aviation (as a whole). Where figures are available, departures are considered to be a more appropriate exposure measure than hours flown as most accidents occur either during the approach and landing or departure phases of flight.

Departures data is not available for individual operation types within general aviation (GA), nor recreational aviation. At the time of publication, departures were only available to 2012 for most operation types, and to 2013 for some types of air transport.

Table 1: Departures (thousands), 2004 to 2013[1]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
All commercial air transport	1,235	1,315	1,275	1,325	1,307	1,279	1,387	1,387	1,425	N/A
High capacity RPT & charter (VH- registered)	380	405	421	439	480	489	537	543	577	597
Low capacity RPT (VH- registered)	204	199	180	168	141	127	132	135	134	128
Low capacity Charter (VH- registered, estimated)[2]	610	667	630	674	640	616	668	657	661	N/A
Foreign-registered	42	45	44	44	47	48	50	53	54	59
All VH- registered general aviation (excluding gliders)	1,974	2,261	1,811	1,794	1,958	1,842	1,994	1,862	1,768	N/A

1 Departures are not available for recreational aviation or gliders.

2 Charter departures are estimated because departures are not recorded separately for different types of operations in the BITRE *General Aviation Activity Survey.* The estimation model calculates the rate of departures per hour flown for aircraft that only perform charter operations. It then uses this ratio to estimate the number of charter-related departures for all aircraft based on the number of charter hours flown. Ratios are specific to aircraft type (aeroplane or helicopter) and number of engines (single or multi-engine).

Charter operations in high capacity aircraft are combined with regular public transport (RPT). Charter operations on low capacity aircraft are reported to BITRE through the *General Aviation Activity Survey*.

Commercial air transport operations have shown a gradual increase in departures across the last 10 years (Figure 1). Within air transport, high capacity regular public transport (RPT) departures have steadily increased since 2004, low capacity RPT departures decreased to 2009 and have increased slowly since then, and charter departures increased slightly (Figure 2). A small, gradual increase in foreign registered aircraft departures has been observed since 2004.

Figure 1: Departures by operation type, 2004 to 2012

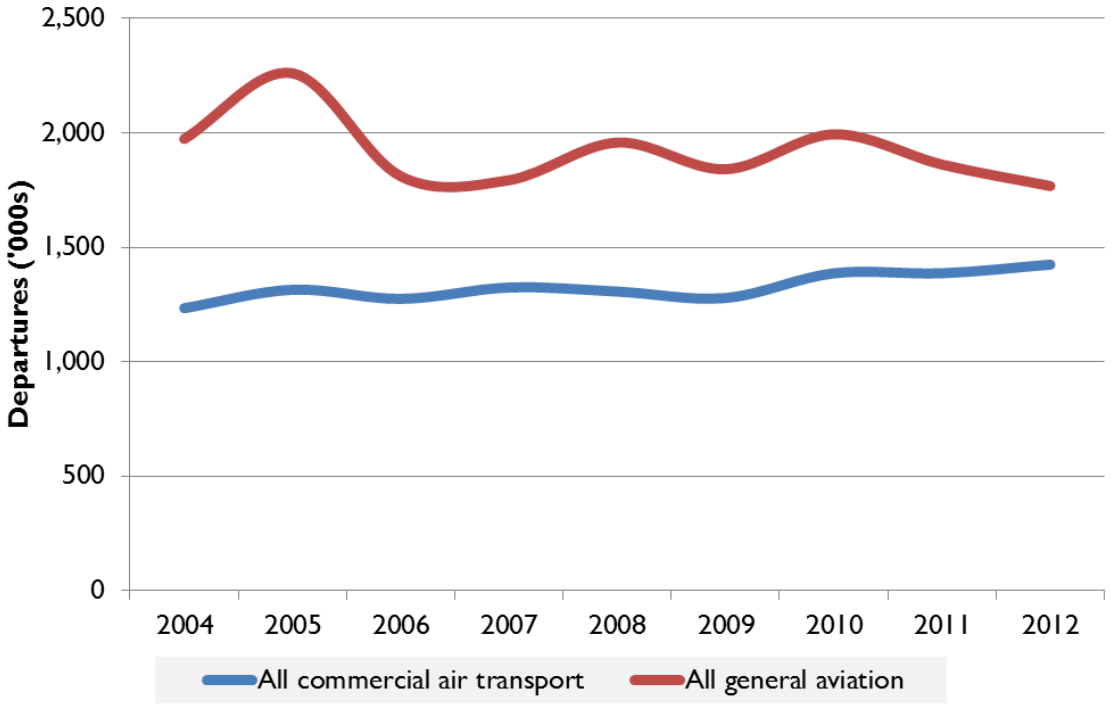
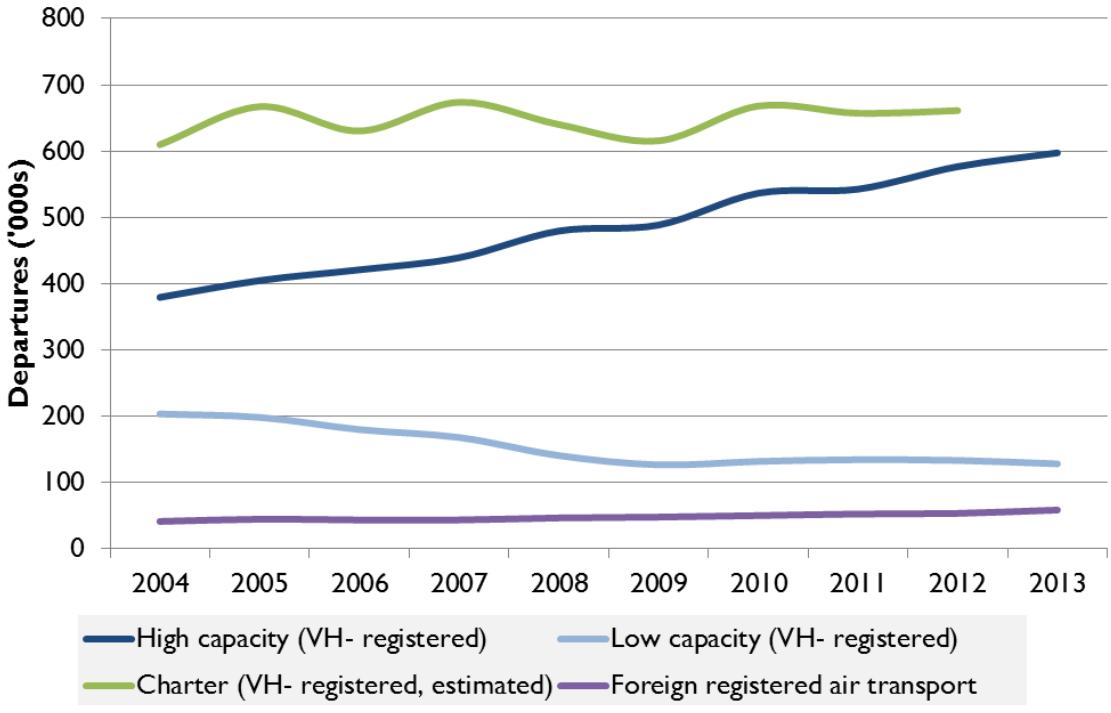


Figure 2: Departures in commercial air transport, 2004 to 2013



Hours flown

While departures are generally used as a measure of exposure for commercial air transport operations, flying hours are a more useful measure of exposure for GA because of the higher risk of an accident outside of the approach/landing and take-off phases of flight (for example, agricultural and search and rescue aircraft performing low flying as part of normal operations).

Table 2 records thousands of hours flown by operation type[3] for Australian (VH-) registered aircraft, and for recreational aircraft registered by a recreational aviation administration organisation (RAAO). At the time of publication, reliable hours flown data was only available to the end of 2012 for most operation types, and to 2011 for most types of recreational aviation.

Table 2: Hours flown (thousands), Australian-registered, 2004 to 2012

	2004	2005	2006	2007	2008	2009	2010	2011	2012
All commercial air transport (VH- registered)	1,563	1,623	1,633	1,733	1,758	1,706	1,852	1,878	1,957
High capacity RPT & charter	883	944	979	1,027	1,112	1,133	1,234	1,271	1,332
Low capacity RPT	205	202	181	167	133	109	116	127	128
Low capacity Charter	475	478	474	539	513	464	502	480	497
All general aviation (VH- registered), (excl. gliders)	1,161	1,238	1,214	1,284	1,337	1,336	1,338	1,284	1,201
All Aerial work	412	426	412	445	464	446	514	509	470
Aerial Agriculture	86	95	62	62	78	73	104	100	89
Aerial Mustering	103	113	102	113	113	106	118	126	113
Aerial EMS	69	69	79	75	82	81	90	88	97
Aerial Search & Rescue	5	7	7	9	9	7	6	7	6
Aerial Survey	34	33	45	54	64	38	58	68	48
Flying training	357	420	429	461	490	501	440	391	365
Private/Business/Sport[4]	393	391	374	379	382	390	384	384	364
Gliders[5]	N/A	212	286	257	184	214	178	159	192
Recreational aviation (Non-VH/RAAO- registered)	251	242	247	258	279	307	285	298	N/A
Gyrocopters[6]	31	30	28	28	30	36	44	49	N/A
Recreational aeroplanes[7]	83	87	113	129	145	163	129	141	N/A
Weight Shift[8]	137	125	106	100	103	109	111	108	N/A

[3] Hours flown are not recorded individually for all types of aerial work that are reported on in these statistics (such as fire control). Hours flown for several categories of aerial work are not collected by the BITRE, so hours flown for 'all aerial work' includes additional types of aerial work categories to those shown in Table 2.
The *General Aviation Activity Survey* collects test and ferry hours as a separate category. In Table 2, test and ferry hours are distributed across charter, aerial work, flying training and private/business/sport operations, based on the expected proportion of test and ferry flights in those categories. Private/business/sport is assigned 11 per cent, flying training 11 per cent, charter 21 per cent, and aerial work is assigned the remaining proportion.

[4] Private/business/sport hours do not include gliders as gliding data was not available for all years in the data range.

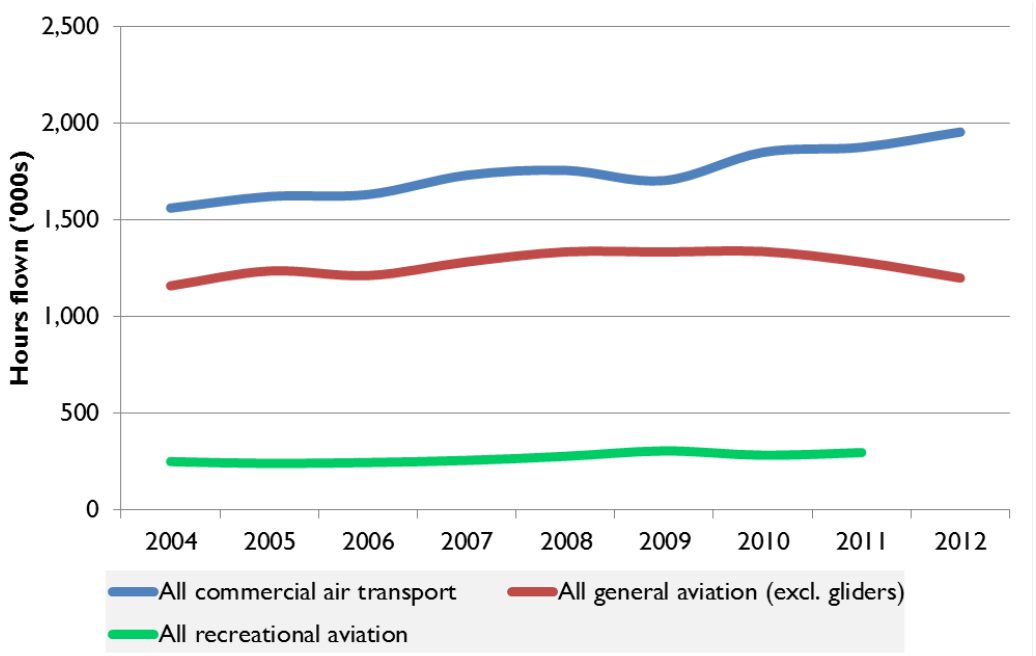
[5] Glider hours flown data is collected by the Gliding Federation of Australia (GFA).Glider hours flown data was not reported to the BITRE by the GFA between 2001 and 2004.

[6] Australian Sport Rotorcraft Association (ASRA) registers and collects all activity data for gyrocopters. Data sourced from BITRE.

[7] Recreational Aviation Australia (RA-Aus) register and collect activity data for recreational (light sport) aeroplanes, including ultralights and some motorised gliders. Data sourced from BITRE.

Since 2009, there has been a growing gap between the hours flown in air transport when compared to GA. While GA flying activity has reduced, recreational flying has shown a slight increase over this period (Figure 3).

Figure 3: Hours flown by operation type, Australian-registered, 2004 to 2012



The majority of commercial air transport flying in Australia is high capacity RPT, and its proportion of total air transport hours flown increased in every year between 2004 and 2012. In comparison, the number of low capacity RPT hours flown was lower in 2012 than in 2004, and charter hours flown remained static (Figure 4).

[8] Both the Hang Gliding Federation of Australia (HGFA) and RA-Aus register and collect activity data for weight shift aircraft, including hang gliders (HGFA only), paragliders (HGFA only), powered parachutes, and weight-shift microlights/trikes. Data sourced from BITRE.

Figure 4: Hours flown in VH-registered commercial air transport, 2004 to 2012

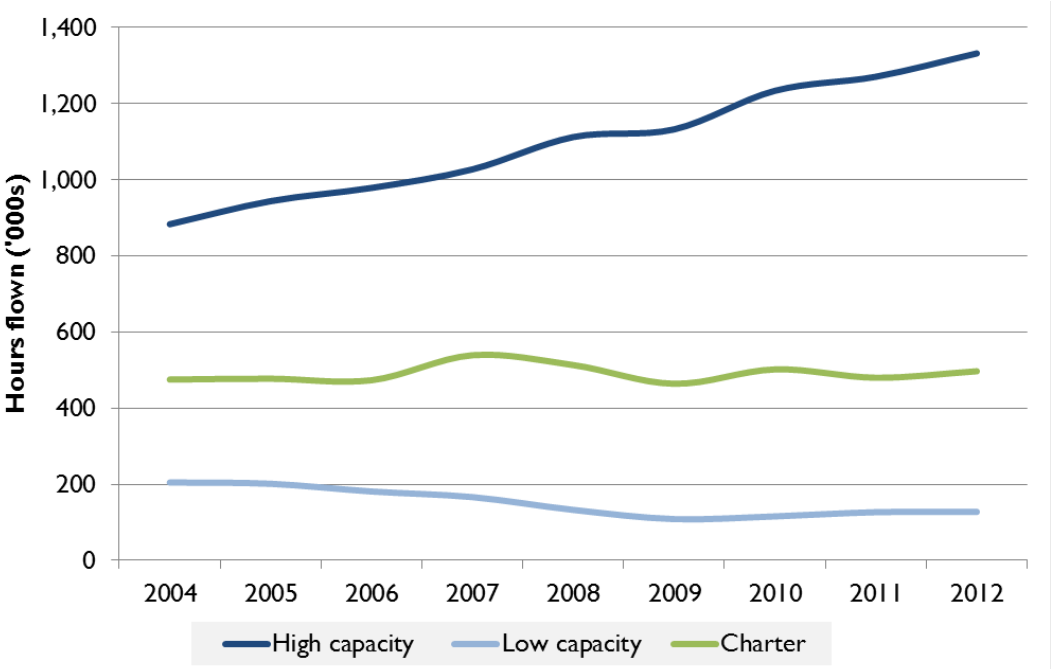
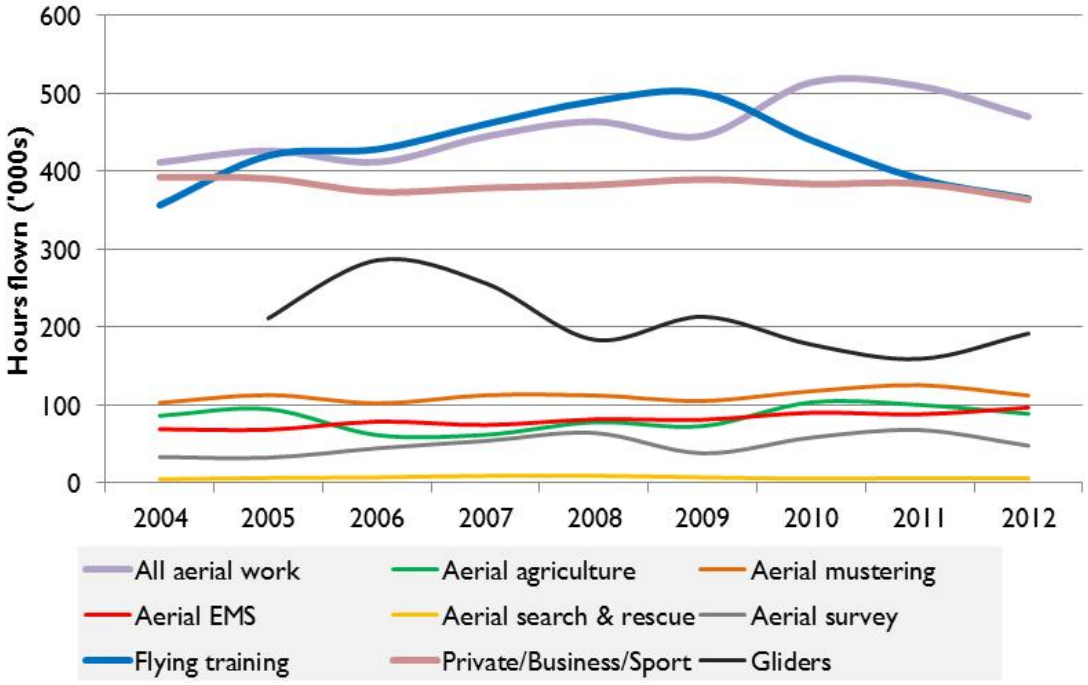


Figure 5 shows a comparison of flying activity across GA. The total number of hours flown in GA has decreased since 2009, particularly in flying training which has fallen by more than one-quarter. In 2012, aerial work made up 39 per cent of all GA flying hours. Private/business/sport flying decreased in 2012, but showed a steady trend across most years. Other types of GA had steady flying activity from 2004 to 2012, although most declined slightly in 2012.

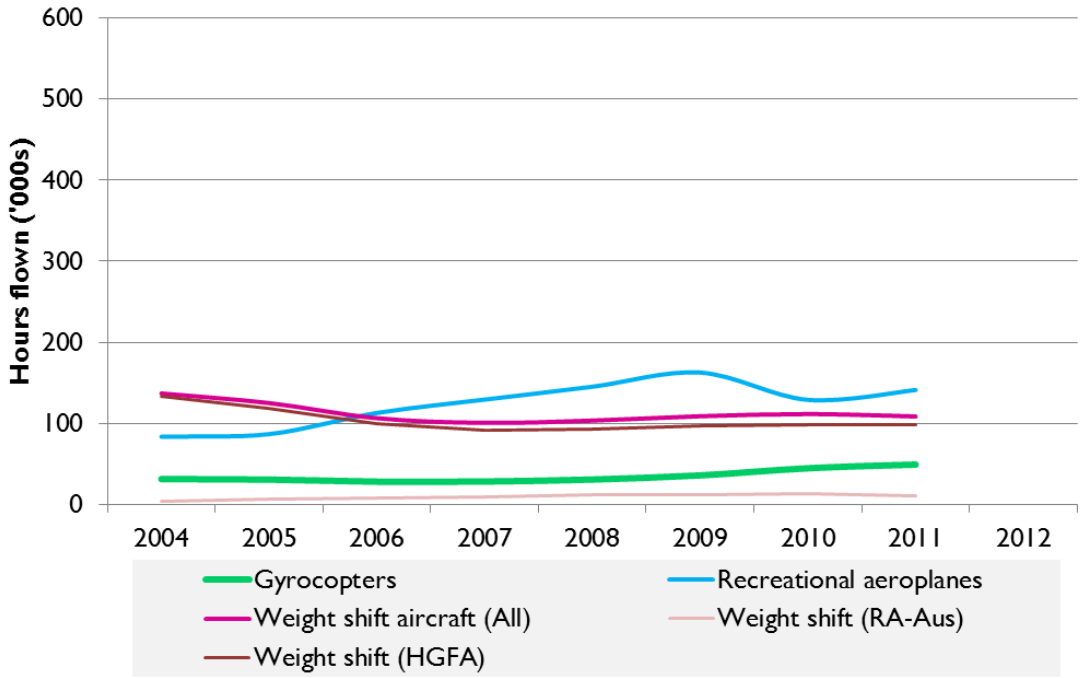
Figure 5: Hours flown in general aviation, 2004 to 2012



Wirestrike involving Ayres S2R Thrush (VH-HAH), 7 km SE of Condobolin Airport, New South Wales (ATSB investigation AO-2013-033)

Activity data (hours flown) is now available for Australian (non-VH) recreational aviation for limited years. Figure 6 shows a comparison of flying activity across different types of RAAO, as reported by each RAAO to the BITRE. For most types of recreational aviation, data was not available for 2012 at the time of publication. RA-Aus registered recreational aeroplanes have shown a significant growth in flying hours over the last 10 years, with two-thirds more hours reported in 2011 when compared to 2004. This is notably higher than other common flying operations, such as high capacity RPT (42 per cent increase over this period), aerial work (24 per cent increase), charter (1 per cent increase), flying training (10 per cent increase), and private and business (decrease of eight per cent over this period). Recreational aeroplane activity differed from other types of recreational flying which showed only a small increase (gyrocopters registered with ASRA) or decreased (weight shift aircraft registered with HGFA) over a similar period.

Figure 6: Hours flown in recreational aviation, 2004 to 2012



More aviation activity statistics are available from the BITRE at www.bitre.gov.au.

Occurrences by operation type

Occurrence numbers and rates presented in the statistics in this section relate to the following operational types:

- **Commercial air transport** - high capacity regular public transport (RPT) flights, low capacity RPT flights, and charter flights
- **General aviation** - aerial work operations, flying training, and private, business and sports aviation (VH– or foreign-registered)
- **Recreational aviation –** aircraft being used for recreational flying that are registered by a recreational aviation administration organisation (RAAO).

Aircraft involved in these occurrences included both Australian civil registered aircraft (both VH– aircraft, and aircraft registered by recreational aviation organisations) operating within or outside of Australian territory[9], and foreign registered aircraft operating within Australian territory. For further information on how the statistics in this report were treated, and how these operational types are defined by the ATSB, see *Appendix A – Explanatory notes*.

Collision with terrain involving Cessna 182R Skylane (VH-AUT), near Hamilton Airport, Victoria (ATSB investigation AO-2013-163)

Table 3 compares the number of fatal accidents and fatalities for commercial air transport, general aviation, and recreational aviation, and each of their subtypes. Fatal accidents in some aircraft operations are more likely to have a greater number of associated fatalities than in other operation types. For example, aircraft used for agricultural operations usually have only the pilot on board (so the number of fatal accidents was the same as the number of fatalities over the last 10 years), whereas survey/photography aircraft generally have a pilot, as well as camera operators or navigators, on board (there were twice as many fatalities as fatal accidents in the last 10 years).

[9] Australian territory refers to mainland Australia, the land areas of Tasmania and Australia's offshore territories. It also includes territorial waters, and coastal waters to the 12 NM limit.

Table 3: Fatal accidents and fatalities by operation type (Australian-registered unless specified), 2004 to 2013

Operation type	Number of aircraft associated with a fatality	Number of fatalities
Commercial air transport	**14**	**36**
High capacity RPT	0	0
Low capacity RPT	2	17
Charter	12	19
Foreign registered air transport	0	0
General aviation	**161**	**247**
Aerial work	42	53
Agriculture	*17*	*17*
Mustering[10]	*5*	*5*
Emergency medical service (EMS)	*2*	*2*
Fire control	*3*	*3*
Survey and photography	*7*	*14*
Other	*8*	*12*
Flying training	9	13
Private/Business/Sport	108	178
Private/Business	*88*	*154*
Sport aviation (excluding gliding)	*5*	*6*
Gliding	*15*	*18*
Foreign registered general aviation	2	3
Recreational aviation	**77**	**94**
Gyrocopters	17	19
Aeroplanes[11]	39	50
Weight Shift	21	25

In 2013, (non-VH registered) recreational aviation had the most accidents and fatal accidents of all operation types. Despite a decrease in the number of accidents when compared to 2012, the number of fatal accidents and fatalities reported doubled. Private/business aviation (which traditionally has made up the greatest share of accidents and fatal accidents) recorded the most fatalities of all operation types in 2013, but there were less than in 2012. In aerial mustering and aerial agriculture (generally higher risk operations) there was also a fall in the number of accidents in 2013, although more serious incidents were reported. In air transport, the number of accidents and serious incidents reported in 2013 remained similar to 2012, with three fatalities and two serious injuries (mostly involving charter operations).

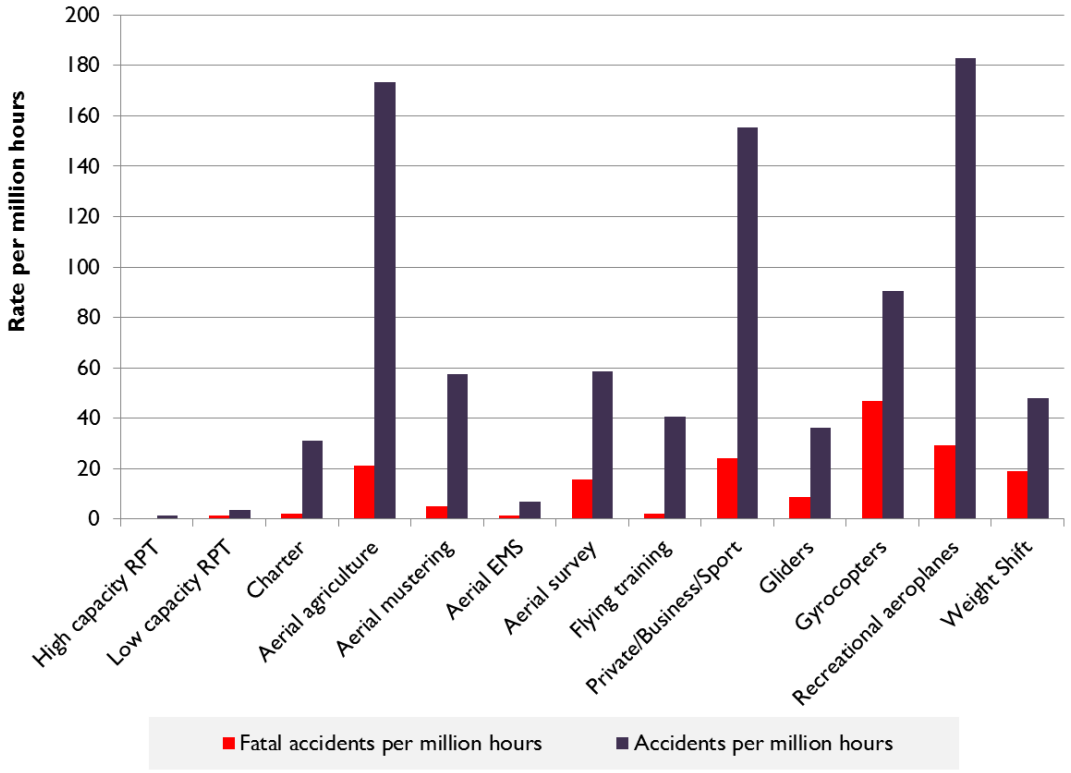
[10] Mustering shows commercial mustering only. In addition, the private/business category includes seven fatal accidents and eight fatalities from private mustering operations.

[11] Includes a single motorised glider.

Figure 7 below shows the rate of accidents and of fatal accidents for each of the specific operation types[12] over this period per million hours flown. Recreational aviation operation types had notably higher accident rates when compared to most general aviation (GA) or air transport operations, although aerial agriculture and private/business/sport flights had the second and third-highest accident rates per million flying hours. When combining VH-registered gliding with private/business/sport operations, the accident rate is the same as that for all non-VH recreational flying combined.

Recreational, private/business/sport, and aerial agriculture operation types were among the most likely to result in a fatal accident when considering the amount of flying activity. However, half of all gyrocopters accidents were fatal (and gyrocopters also had the worst fatal accident rate per million hours flown), a third of weight shift aircraft accidents were fatal, and about a quarter of gliding and aerial survey and photography accidents were fatal. More detailed information on accident rates for each operation type is provided in the following sections of this report.

Figure 7: Rate of accidents and fatal accidents (Australian-registered aircraft only) by operation type, 2004 to 2012



[12] Activity data for each operation type is provided by the Bureau of Infrastructure, Transport and Regional Economics (BITRE), except for the following where information on hours flown and number of departures was not collected between 2004 and 2012: Fire control, Other/unknown GA, Sport aviation, Foreign-registered GA.

Accident and fatal accident rates are based on those accidents from 2004 to 2012 only, as activity data was not yet available for 2013 at the time of writing. Recreational aviation accident rates are based on accidents from 2004 to 2011, and gliding accident rates are based on 2005 to 2012,as data was only available for those years at the time of writing. Private/Business/Sport excludes gliding.

Recreational aeroplane accident rates includes a single motor glider fatal accident.

Commercial air transport

The number of reportable safety incidents in commercial air transport has increased in almost every year over the last 10 years (Table 4). This is a sign of growing flying activity in most types of air transport, and a greater awareness among operators of their reporting requirements to the ATSB.

Serious incidents are indicators of events that almost led to accidents. As such, they represent occurrences which could have had more serious consequences. The number of serious incidents in 2013 in commercial air transport was higher than average, and was the highest number in the last 10 years (Figure 8). Compared to 2012 (where a rise in serious incidents was contained to charter operations), the number of serious incidents in high capacity RPT almost doubled.

In 2013, there was one accident reported involving two RPT aircraft. There were 12 accidents involving charter aircraft, which was below the yearly average (15) for the last 10 years.

There were two fatal accidents (charter operations) and two serious injury accidents in commercial air transport in 2013. These numbers change little between years, and are low in comparison to almost all other types of aviation.

Table 4: All commercial air transport occurrences (VH- and foreign registered aircraft), 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	2,760	3,229	2,982	3,059	3,216	3,038	3,375	3,885	4,067	4,261
Serious incidents	30	31	16	45	47	24	34	27	40	49
Serious injury accidents	1	1	2	0	1	3	2	2	2	2
Fatal accidents	0	2	1	2	3	0	1	2	1	2
Total accidents	16	12	12	22	29	11	23	21	14	14
Number of people involved										
Serious injuries	1	2	0	1	15	3	2	2	2	3
Fatalities	0	18	2	2	6	0	2	2	1	3
Rate of aircraft involved										
Accidents per million departures	13.1	9.2	9.5	16.7	22.3	8.7	16.7	15.2	9.9	N/A
Fatal accidents per million departures	0	1.5	0.8	1.5	2.3	0	0.7	1.4	0.7	N/A

Figure 8: Commercial air transport occurrences and injuries, 2004 to 2013

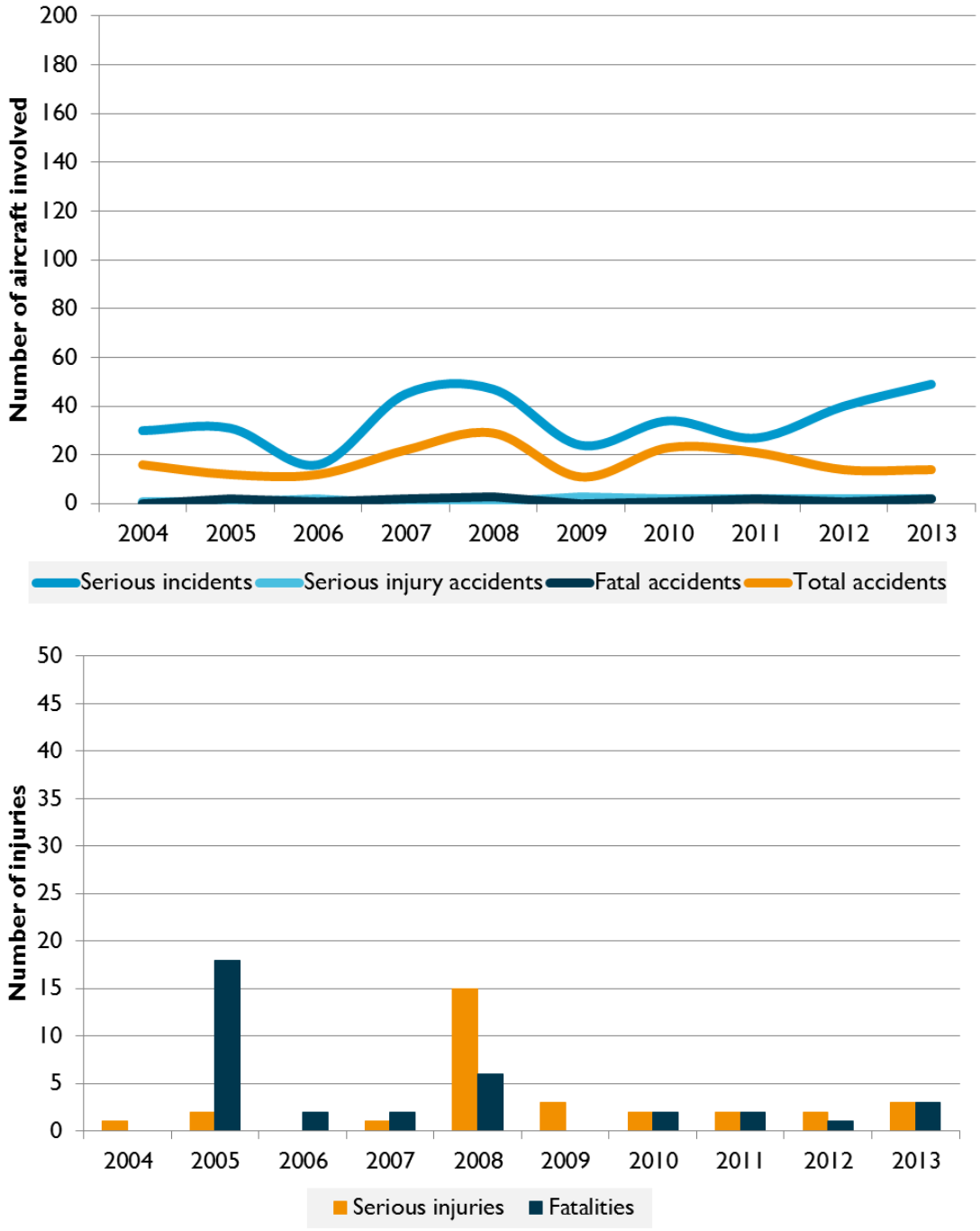
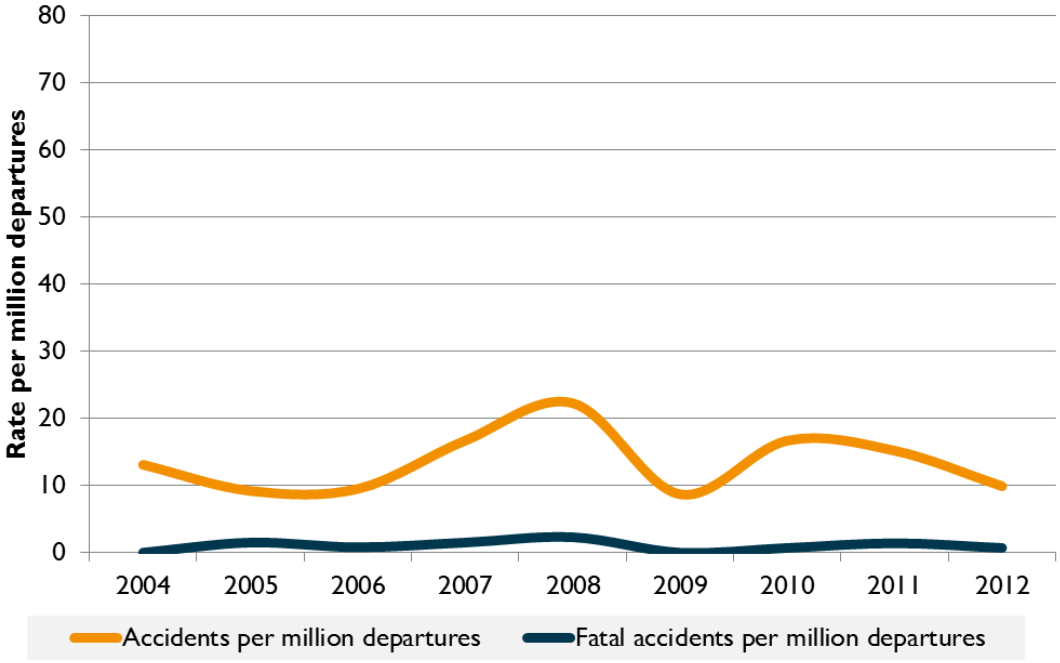


Figure 9: Commercial air transport accident and fatal accident rate (per million departures), 2004 to 2012



Collision during pushback operations between Boeing 737-800 (VH-YID) and Airbus A320-200 (VH-VGR), Melbourne Airport, Victoria (ATSB investigation AO-2013-033)

High capacity RPT and charter (VH- registered)

The number of incidents reported to the ATSB by Australian airlines over the last 10 years has risen significantly, with about twice the number of occurrences involving VH- registered high capacity RPT aircraft reported today as in 2004 (Table 5). When considering this increase, it is important to note that flying activity in high capacity RPT has increased steadily across this period (departures rose 62 per cent from 2004 to 2013).

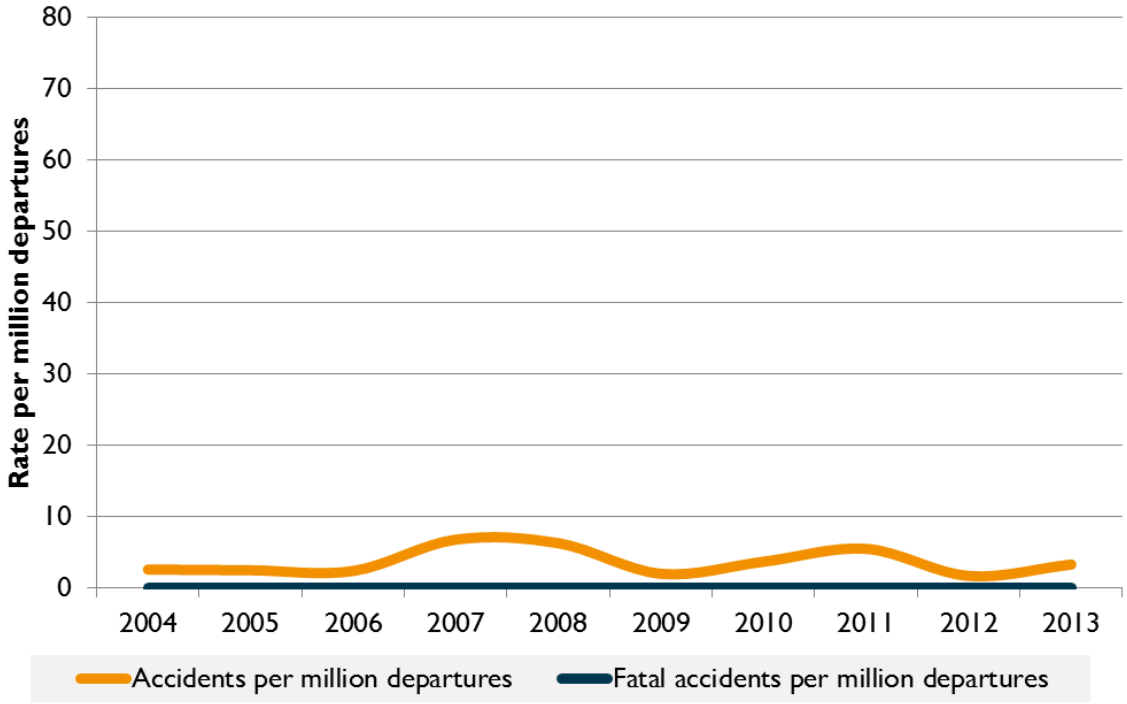
While there were two Australian-registered high capacity RPT aircraft involved in one accident in 2013 (Figure 10), the number of aircraft involved in serious incidents doubled when compared to 2012. The 22 aircraft involved in serious incidents was the highest number for this operation type in more than 10 years.

No fatalities involving VH- registered high capacity RPT aircraft operations have occurred since 1975.

Table 5: High capacity RPT (VH- registered aircraft) occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	1,705	2,053	1,900	1,918	2,133	2,016	2,433	2,857	3,109	3,292
Serious incidents	10	11	4	16	20	10	13	13	12	23
Serious injury accidents	0	1	0	1	12	1	2	1	0	1
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	1	1	1	3	3	1	2	3	1	2
Number of people involved										
Serious injuries	0	1	0	1	1	1	2	1	0	1
Fatalities	0	0	0	0	0	0	0	0	0	0
Rate of aircraft involved										
Accidents per million departures	2.6	2.5	2.4	6.8	6.3	2	3.7	5.5	1.7	3.3
Fatal accidents per million departures	0	0	0	0	0	0	0	0	0	0
Accidents per million hours	1.1	1.1	1	2.9	2.7	0.9	1.6	2.4	0.8	1.5
Fatal accidents per million hours	0	0	0	0	0	0	0	0	0	0

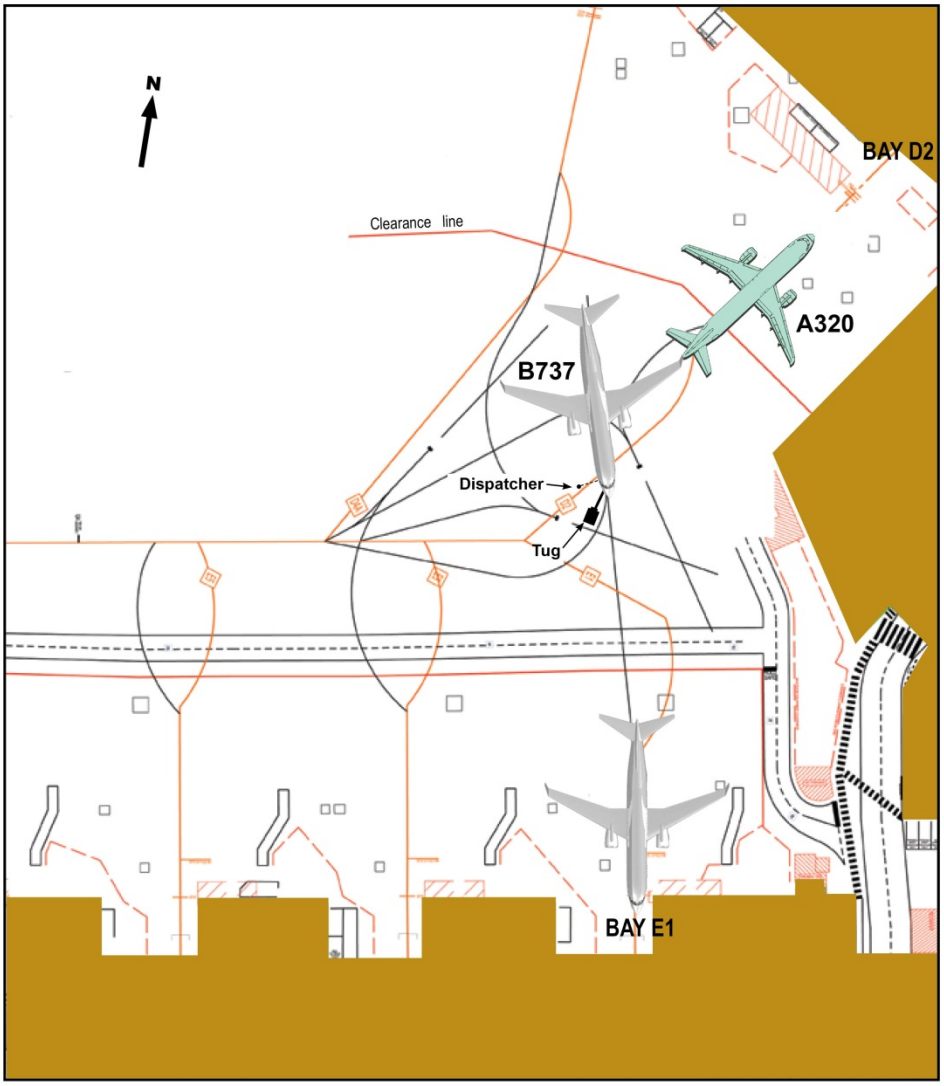
Figure 10: Accident rate for high capacity RPT aircraft (VH- registered) (per million departures), 2004 to 2013



There was one accident (involving two VH- registered aircraft) and 19 serious incidents across all high capacity RPT operations in 2013 (involving 22 VH- registered aircraft and one foreign-registered aircraft). These primarily involved separation issues between other aircraft or ground vehicles, or inadvertent weather affecting the safe operation of the aircraft. The serious incident that involved foreign-registered aircraft is discussed separately on page 31. The other accidents and serious incidents involving Australian VH- registered aircraft are discussed below:

- A Virgin Australia Boeing 737 was being pushed back from gate E1 at Melbourne Airport terminal. At the same time, a Jetstar Airbus A320 was stationary on a taxi line behind and to the left of the Boeing, waiting to dock at gate D2. During the pushback of the Boeing, the two aircraft collided, resulting in damage to the left winglet of Boeing and to the tail cone of the Airbus. There were no reported injuries to persons on the aircraft or to ground staff. The Boeing was being pushed back by a tug, using a towbar connected to the nosewheel to steer and push the aircraft. The pushback was being controlled by a dispatcher who was walking beside the aircraft on the right side. The ATSB determined that the left wing could not be seen from the dispatcher's position, and the flight crew reported they could only see the wingtips with difficulty from the cockpit. The Boeing had been approved by the surface movement controller (SMC) to push back from gate E1 once the Airbus was 'on the gate' for gate D2. The Airbus, which was taxiing to the gate at the time the surface movement controller had given the Boeing clearance, had stopped about 20 m before its intended parking position due to a 'STOP WAIT' display on the automatic visual guidance display system. The Airbus crew notified the SMC they had stopped short (and outside of the clearance line for gate D2), but due to an over-transmission this was not heard by the SMC or the Boeing crew. The Boeing flight crew relayed the pushback approval to the dispatcher including the caveat of 'once the Airbus was on the gate'. The dispatcher recalled that he looked under the Boeing fuselage and after he had observed the Airbus stopped for some time and believing that the aircraft was on the gate, initiated the pushback. The tug driver concentrated on directional control to keep the Boeing following the marked lines for the pushback. The ATSB determined that from the dispatcher's viewpoint it was not possible to see the clearance line for gate D2, or to see enough to ensure that an aircraft was on the gate at D2. The ATSB identified that the SMC was dealing with a high workload at the time controlling many aircraft, and was situated 1.5 km away in the

Melbourne Airport control tower. The ATSB investigation is continuing (ATSB investigation AO-2013-125).



Collision during pushback operations between Boeing 737-800 (VH-YID) and Airbus A320-200 (VH-VGR), Melbourne Airport, Victoria (ATSB investigation AO-2013-033) – diagram shows the movement of each aircraft leading up to the collision

- A Virgin Australia ATR 72 aircraft on an instrument flight rules (IFR) flight from Sydney was inbound to Port Macquarie when the crew heard a taxi call from the crew of a Qantaslink Bombardier DHC-8. The crews of both aircraft discussed their respective positions and intentions and the DHC-8 crew stated that they would advise the ATR crew when they were about to take-off. When lined up on the runway, the DHC-8 crew observed the ATR on the aircraft's traffic alert and collision avoidance system (TCAS) positioned directly overhead the airport and turning outbound in the holding pattern and broadcast a call advising them that they were about to commence the take-off run. Both aircraft were also communicating with a number of other aircraft operating in the area at the time for aircraft separation. When on downwind, approaching 3,000 ft in instrument meteorological conditions (IMC), the captain of the DHC-8 observed an aircraft on the TCAS, above the DHC-8. The captain identified the aircraft as the ATR and instructed the first officer to stop the climb and turn the aircraft to the right. Shortly after, the DHC-8 crew received a TCAS traffic advisory (TA) and then an initial resolution advisory (RA) to descend, followed shortly after by an RA to 'adjust vertical speed'. At the same time, while also in IMC, the crew of the ATR also reported receiving a TCAS TA and then a TCAS RA to climb. The captain of the ATR immediately responded and climbed the

aircraft. Both flights continued without further incident. This serious incident is a reminder of how essential it is that pilots monitor their surroundings and have an awareness of traffic disposition. It is important to know where the traffic is and where it will be in relation to you, so that potential issues can be identified and actioned, before they escalate. This is particularly important when operating at non-towered aerodromes, where aircraft separation is pilot responsibility (ATSB investigation AO-2013-038).

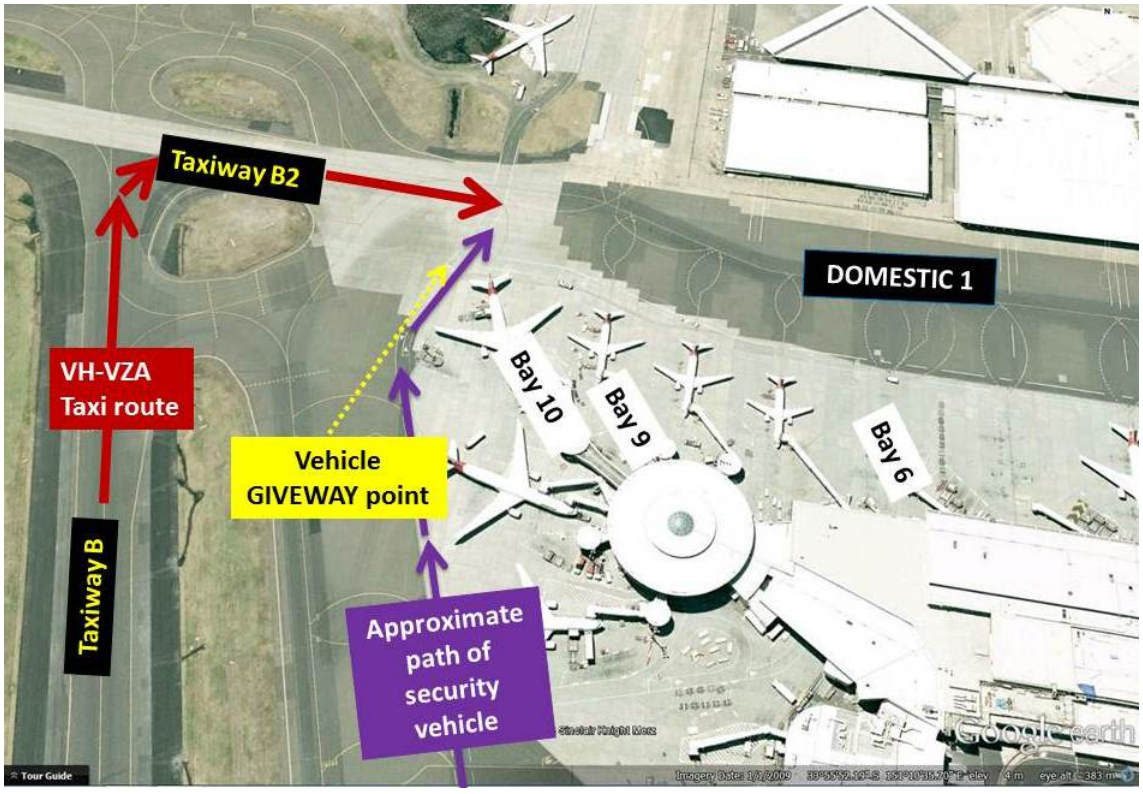
- A Qantas Airbus A330 was tracking from IFR reporting point HORUS to the Melbourne Airport runway 16 instrument landing system (ILS) final approach fix (FAF). After being given a visual approach clearance at 10 NM north east of Melbourne, the flight crew informed air traffic control that they were conducting a missed approach from approximately 2,000 ft at 7 NM from the FAF due to a ground proximity warning. The aircraft was re-sequenced via the runway 16 ILS without further incident. The ATSB is currently investigating this serious incident (ATSB investigation AO-2013-047).
- During cruise, the first officer (and pilot flying) of a Virgin Australia Embraer E-190 became unwell due to stomach pains and appendicitis symptoms, and the captain took over pilot flying duties for the remainder of the flight. (ATSB occurrence 201303984).
- During cruise on a flight from Townsville to Cairns and flying in clear air, the Qantaslink Bombardier DHC-8 encountered light turbulence. The captain immediately switched on the seal belt sign, and a second later, the aircraft encountered abrupt severe clear air turbulence. The weather event had not been detected on weather radar. The autopilot disconnected and the captain, as pilot flying, assumed manual control of the aircraft. The flight crew reduced the speed of the aircraft to below the turbulence penetration speed. The turbulence event lasted about 10 seconds, during which time the aircraft climbed about 400 ft above the cruising altitude. The flight crew then re-engaged the autopilot and returned the aircraft to the assigned level. The turbulence caused severe injuries to two cabin crew members who were standing at the time as they impacted the cabin roof and then fell to the floor, including head injuries and unconsciousness. The aircraft landed in Cairns about 20 minutes later and the injured cabin crew were transferred to hospital. In this event, all passengers were seated with their seat belts fastened, even though the seat belt sign had been switched off earlier. The fact that none of the passengers were injured highlights the benefits of keeping your seatbelt fastened during the flight (ATSB investigation AO-2013-084).
- During approach into Sydney in unforecast adverse weather conditions, the crew of a Qantas Boeing 747 travelling from Los Angeles declared a PAN due to low fuel quantity and the aircraft subsequently landed in poor visibility with fuel reserves intact (ATSB occurrence 201304601).
- During approach into Roma, the crew of the Qantaslink Bombardier DHC-8 received a TCAS RA on a Bell 412 helicopter engaged in emergency medical service (EMS) operations and manoeuvred to ensure separation. The DHC-8 crew reported not hearing the taxi broadcast from the 412 crew (ATSB occurrence 201305094).
- The flight crew of the Boeing 737 were conducting an independent visual approach (IVA) to runway 16R at Sydney Airport. Air traffic control (ATC) provided the flight crew with tracking and speed instructions to position the aircraft for a landing. The flight crew were then advised by ATC that they may be taken off the approach due to medical priority traffic departing out of Bankstown, NSW. The final tracking instructions from ATC positioned the aircraft to intercept the extended runway centre-line before the crew was cleared for a visual approach to runway 16R. However, the aircraft failed to intercept final on runway 16R, and as the aircraft approached the extended runway centreline, the TCAS alerted the flight crew to another aircraft (an Airbus A320) on approach to the parallel runway. The pilot flying responded to the TCAS RA by disconnecting the autopilot and following the TCAS instructions to descend. The Airbus flight crew also received a TCAS RA alert, and conducted a missed approach in response. Almost simultaneously with the TCAS alert, the Boeing flight crew realised that the aircraft was continuing through the extended centre-line of runway 16R, and that the approach

(APP) mode was not armed as intended. When the alert ceased, the pilot flying armed the approach and captured the extended runway centre-line from the other side, having flown through the centre-line by about 300 m. The flight crew continued the approach and landed. The ATSB investigation, which was underway at the time of writing, has found that the aircraft's Mode Control Panel was not armed in APP mode, which allows the aircraft's auto-flight system to capture and track the localiser associated with the intended landing runway. The flight crew of the Boeing were not aware of this until the time of the TCAS RA. The investigation is continuing to look at the human factors associated with auto-flight mode system awareness, procedures and training, and IVA procedures at Sydney Airport (ATSB investigation AO-2013-095).

- On a flight from Brisbane to Adelaide, the weather conditions at Adelaide deteriorated due to heavy fog with a zero cloud ceiling, and the crew of the Virgin Australia Boeing 737 were forced to divert to an alternate airport (Mildura, Vic.) The fog at Adelaide was not forecast when the aircraft left Brisbane. Upon arrival at Mildura, the crew discovered that the weather was not as reported, with the airport also affected by unforecast fog and low cloud. After extended holding, the flight crew declared a fuel emergency and landed at Mildura (ATSB investigation AO-2013-100).
- A second flight diversion occurred with the same circumstances and on the same morning as the occurrence above, where a Qantas Boeing 737 en route from Sydney to Adelaide was forced to divert to Mildura due to an unexpected change in the weather forecast for Adelaide. Upon arrival at Mildura, the crew discovered that the weather was not as reported, with the cloud base below the minima and obscuring the runway threshold. With insufficient fuel to divert to another airport (no fuel emergency was declared), the flight crew decided to land, and became visual with the runway 100 ft below the minima. Both this serious incident and the one above are being systemically investigated by the ATSB, with the investigation focusing on the provision of information from ATC to flight crews and the accuracy of aviation meteorological services and products provided by the Bureau of Meteorology (ATSB investigation AO-2013-100).
- During a very high frequency omindirectional range (VOR) approach to Avalon Airport, Vic., the Jetstar Airbus A320 was in an unstable configuration and conducted a missed approach to runway 36, during which time there was a loss of separation with a departing Bell 412 helicopter. As the ATC tower at Avalon was closed at the time, the airspace immediately above Avalon Airport revered to uncontrolled (Class G) to a height of 700 ft above ground level (AGL). Above this height, ATC was being provided by a controller also responsible for Melbourne Departures. As a result, instrument flight rules (IFR) aircraft operating into and out of Avalon were required to monitor both the Common Traffic Advisory Frequency (CTAF) and the Avalon Approach frequency. The controller, who did not have the ability to monitor the CTAF, instructed the Bell pilot using the Approach frequency to expedite his departure so that the Airbus could land. The Bell pilot made all appropriate broadcasts on the CTAF and departed, however, a very strong westerly wind at the time of the occurrence reduced the helicopter's speed and climb rate. The controller also advised the Airbus crew that the Bell had just become airborne on the Approach frequency, but the ATSB investigation found that it was unlikely the flight crew heard the full transmission as it coincided with the Bell's departure call on the CTAF. The controller repeated this advice to the Airbus crew, but received no response (a review of relevant audio recordings found that the Airbus crew had replied, but on the CTAF instead of the Approach frequency). As the helicopter climbed through 1,900 ft, ATC instructed the Bell pilot to turn onto a heading of 260°, but due to the strong wind the helicopter's track was almost northerly. At about the same time, the Airbus crew conducted a missed approach as the aircraft had become high on the descent profile. At this time the Bell had crossed the extended centreline of runway 36, and the controller attempted to maintain separation by instructing the Airbus crew to stop their climb. He received no response, as the Airbus crew had responded on the CTAF that they were unable to comply with these instructions. The controller instructed the Airbus crew to make an immediate right turn and advised them of the

location of the Bell, which they followed. Separation reduced to 1.5 NM and 600 ft as the Airbus was turned away from the Bell. As a result of this occurrence, Airservices is currently undertaking a review of the risk profile associated with Avalon operations and airspace design (ATSB investigation AO-2013-115).

- During landing at Moranbah, Qld, the right undercarriage of a Virgin Australia ATR 72 left the runway surface. The ATSB investigation is ongoing (ATSB investigation AO-2013-114).
- During the taxi to the parking bay area at Cairns Airport, the captain of a Qantas Boeing 737 observed the lights of a security vehicle approaching about 50 m from the right side of the aircraft near the intersection of the airside road and taxiway B2. The captain thought the vehicle would continue along the airside road, however, as the car continued in a northerly direction across the intersection the captain believed it was on a collision course with the Boeing. Realising the vehicle driver had not seen the aircraft, the captain immediately stopped the aircraft. The security vehicle continued toward the aircraft, then came to an abrupt stop about 10 m to the right of the aircraft's nose. The ATSB investigation determined that the vehicle driver had slowed down as he approached the taxiway B2 intersection and looked towards the taxiway on his left, but did not see the lights of the Boeing and continued to drive into the parking bay area to the right assuming the area was clear (ATSB investigation AO-2013-135).



Ground proximity event between Boeing 737-800 (VH-VZA) and a security vehicle at Sydney Airport, New South Wales (ATSB investigation AO-2013-135) – diagram shows the relative positions of the aircraft and vehicle

- During climb overhead Brisbane Airport passing 10,000 ft, a weather balloon passed in close proximity to an Alliance Airlines Fokker 100. The weather balloon had recently been released from the Bureau of Meteorology office at Brisbane Airport (ATSB occurrence 201307906).
- Air traffic control received a short term conflict alert (STCA) on a Tigerair Airbus A320 and a Qantas Boeing 737 on a converging course in Class A airspace near Hay, NSW. Both aircraft were operating between Melbourne and Cairns, but in opposite directions. This particular air route was unusual, as most air routes in this airspace are one-way routes. The crew of the Airbus had planned to operate at flight level (FL) 360, and the crew of the Boeing had planned

to operate at FL360 to a position inland and abeam Emerald, Queensland, and then at FL370 to Melbourne. However, the change of level planned by the crew of the Boeing had not been initiated, resulting in both aircraft converging at the same flight level. The controller initiated avoiding action by turning both aircraft and instructing the Boeing to descend. Separation was maintained throughout, however, there was a loss of separation assurance. The ATSB investigation found that the controller's focus was on monitoring the Airbus's climb through the levels of a number of aircraft on crossing air routes, and they only became aware of the aircraft converging at the same level when the STCA activated. As a result of this occurrence, Airservices will review the Melbourne to Cairns air route with regard to creating one-way routes, and review similar routes nationally. In addition, Airservices has issued a directive reminding controllers of their responsibilities regarding the application of non-standard levels and subsequent return to standard levels. In this incident, the timely activation of the STCA and the controller correctly using compromised separation techniques ensured that the separation standards were not infringed (ATSB investigation AO-2013-138).

- During cruise near Adelaide, a Qantas Airbus A330 travelling from Perth to Sydney at FL390 was cleared to climb resulting in a loss of separation with an opposite direction Qantas Airbus A330 travelling from Sydney to Perth at FL380. Both aircraft were within radar surveillance coverage at the time of the occurrence. The loss of separation occurred when the controller approved a request from the westbound aircraft to climb from FL380 to FL400. Although the crew of the westbound Airbus stopped their climb when the controller received a STCA, the flight crew of the eastbound Airbus received a TCAS TA followed by a TCAS RA to climb after visually identifying the other aircraft. Immediately after the occurrence, the crew of the westbound aircraft reported to ATC that they did not receive a TCAS alert, and did not see the eastbound Airbus. Further investigation of the TCAS in the westbound aircraft found a failure between the transponder and the TCAS computer and antennas. The ATSB investigation is continuing and will look further into the reliability and availability rates of TCAS, as well as the context of the controller's actions (ATSB investigation AO-2013-161).
- Approaching top of climb on a flight from Sydney to Perth, the crew of a Qantas Airbus A330 detected a discrepancy with the computerised flight plan (CFP) fuel requirements and determined that insufficient fuel was loaded to meet a change in the destination aerodrome forecast holding requirements. Due to improving weather at Perth, the flight was able to continue to the destination. The ATSB investigation found that the initial flight plan and weather package was downloaded to the pilot and first officer's iPad, but when a new flight plan and weather package was released by company dispatch due to forecast fog in Perth, the first officer inadvertently downloaded the initial flight plan. As a result of this occurrence, the aircraft operator has highlighted the occurrence to the dispatch team and issued an Internal Notice to Airmen to the flight crews to ensure they are in receipt of the latest flight plan data before flight (ATSB investigation AO-2013-182).
- The flight crew of a Qantas Boeing 767 prepared to conduct a flight from Melbourne to Sydney, obtaining relevant weather information with no requirements for an alternate or additional fuel for holding. During the approach into Sydney, the aircraft encountered moderate turbulence for 2 minutes and the flight crew observed lightning near the aircraft's track. The crew elected to discontinue the approach, and during the climb the aircraft encountered severe turbulence. The crew reported that full go-around power was required to maintain altitude and speed, and they experienced difficulty controlling the aircraft. The crew orbited for 20 minutes, and attempted to conduct another approach. The aircraft again encountered severe turbulence and the crew rejected this second approach, making the decision to declare a PAN and divert to Williamtown. A number of passengers suffered minor to serious injuries due to the turbulence, including one passenger who was struck by an iPad (ATSB investigation AO-2013-209).
- During the landing roll at Dallas/Fort Worth International Airport in the United States, the Boeing 747 struck a foreign object resulting in failure of an engine. The aircraft was taxied clear of the runway and stopped on an adjacent taxiway. After the non-normal checklist was actioned, the aircraft was taxied to the bay (ATSB occurrence 201312220).

Low capacity RPT (VH- registered)

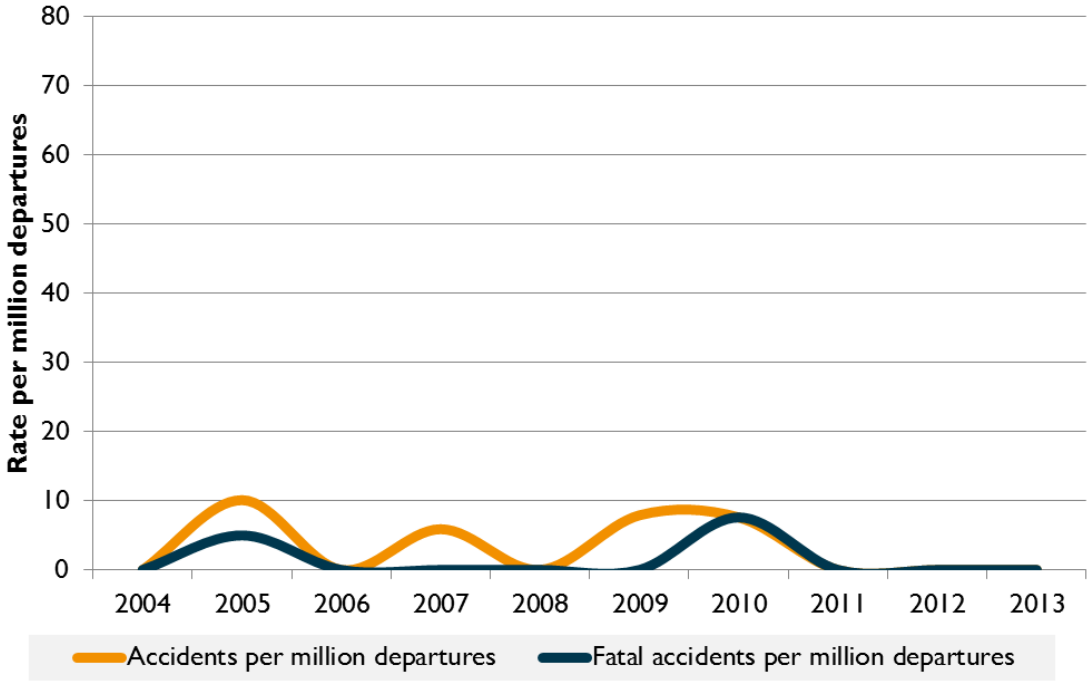
Where reports of incidents have been increasing in other types of commercial air transport (particularly in high capacity RPT), the number of incidents reported to the ATSB involving low capacity RPT aircraft has declined over the last 10 years to a low in 2013 (Table 6). This is primarily due to a decline in flying activity over this period (in both hours flown and number of departures). This decline is a combined result of Australia's mining boom (larger aircraft are needed to move more people to regional cities and mining communities), regional airlines using aircraft with larger seating capacities (moving many former lower capacity flights into the high capacity aircraft range), and the additional regional travel options provided by high capacity RPT operators.

There were no accidents, and three serious incidents reported in 2013 that involved low capacity RPT operations (Figure 11).

Table 6: Low capacity RPT (VH- registered aircraft) occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	525	572	468	481	394	405	440	457	393	372
Serious incidents	10	7	5	8	11	4	6	2	5	3
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	1	0	0	0	0	1	0	0	0
Total accidents	0	2	0	1	0	1	1	0	0	0
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	15	0	0	0	0	2	0	0	0
Rate of aircraft involved										
Accidents per million departures	0	10.1	0	5.9	0	7.9	7.6	0	0	0
Fatal accidents per million departures	0	5	0	0	0	0	7.6	0	0	0
Accidents per million hours	0	9.9	0	6	0	9.2	8.6	0	0	0
Fatal accidents per million hours	0	5	0	0	0	0	8.6	0	0	0

Figure 11: Accident rate for low capacity RPT aircraft (VH- registered) (per million departures), 2004 to 2013



The serious incidents involving low capacity RPT aircraft in 2013 are detailed below:

- A Regional Express Saab 340 was conducting a passenger service from Sydney to Taree, NSW. During the approach to Taree, the crew monitored the weather conditions, which included a strong crosswind. The crew became visual with the runway at about 700 to 800 ft AGL, and assessed the approach as suitable to land. The crew reported light rain and fluctuating wind. The aircraft touched down and the crew applied reverse thrust, and immediately after the crew reported there was a gust of wind the caused the left wing to lift and the aircraft to weathercock to the left. The aircraft veered left towards the runway edge and the captain applied right rudder, but the aircraft did not respond. As airspeed decreased, the captain also applied right brake with no effect, and simultaneously commenced nose wheel steering using the tiller. As the captain believed that the nose wheel steering was ineffective, he elected to apply asymmetric thrust by reducing the amount of reverse thrust on the left engine and increasing reverse thrust on the right engine. The aircraft commenced moving to the right. The aircraft slowed and was taxied to the parking area. After shutdown, the first officer conducted a post flight inspection using torchlight, and did not find any damage. The next day, the aircraft returned to Sydney, at which time maintenance personnel conducted an inspection of the aircraft and observed damage to the left propeller blades. All four blades had sustained stone damage predominantly on the back (reverse) of the blades (ATSB investigation AO-2013-061).
- A Hardy Aviation Fairchild SA227 Metroliner was about to take off from Bathurst Island, NT on a flight to Darwin. The flight crew made all appropriate broadcasts on the CTAF, and after take-off, made another call advising that they were departing the circuit on the downwind leg on climb to 5,000 ft. At the same time, an Aerospatiale AS.350 helicopter was taxiing at Barra Base, near Port Hurd for a ferry flight to Darwin. The pilot made both a taxi and an airborne broadcast on the CTAF, and was planning to overfly the Bathurst Island Airport and along the coast to Darwin. When at 16 NM and at 7 NM from Bathurst Island, the helicopter pilot made a call on the CTAF advising he was overflying the aerodrome and then flying coastal at 2,500 ft. While the Metroliner was on downwind, climbing through 2,000 ft, the flight crew sighted a helicopter less than 100 ft above and 400 m to the right. The Metroliner descended and the Aerospatiale passed overheads (ATSB investigation AO-2013-105).

- A Cessna 185 parachuting aircraft departed Moruya, NSW for a parachute drop overhead the airport. About 15 minutes later, the flight crew of a Regional Express Saab 340 made a broadcast on the CTAF that they were taxiing for departure from Moruya. The pilot of the Cessna responded with a broadcast of his intentions to drop parachutes overhead. The Saab crew then commenced the take-off, intending to conduct a right turn overhead the airport to depart towards Merimbula. Soon after, the parachute drop was completed, and the pilot broadcast that three parachute canopies would be opening below 5,000 ft. A few minutes later as the Saab was climbing through 3,500 ft and tracking overhead the airport, the flight crew asked the Cessna pilot to confirm the drop had been completed, and questioned the altitude, time, and position of the drop. The Cessna pilot advised the parachutists had been dropped about 0.4 NM west of the airport overhead the Moruya racecourse, about 30 seconds previously, and he was not aware that the Saab was flying overhead the airport. Identifying a potential conflict, the Saab flight crew immediately turned the aircraft left. The flight continued without further incident (ATSB investigation AO-2013-150).

Charter (VH- registered), low capacity

The number of incidents reported to the ATSB involving Australian-registered aircraft conducting charter work has been stable for most of the last 10 years. Of all air transport operations, charter had the highest total number and highest rates of accidents and fatal accidents over most years (Figure 12). The accident and fatal accident rate per million hours was higher than for departures (Figure 13), which reflects the short duration of most charter flights and hence a greater exposure to approach and landing accidents (due to more departures per hour flown).

The number of accidents involving charter aircraft has varied significantly from year to year, but has fallen for the last 3 years (Table 7). In contrast, the number of serious incidents reported in 2013 continued to increase, and there were more fatalities than usual.

Table 7: Charter (VH- registered aircraft) occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	349	419	466	521	553	493	356	402	399	401
Serious incidents	9	6	6	16	13	9	14	11	20	22
Serious injury accidents	1	1	0	0	2	1	0	1	2	1
Fatal accidents	0	1	1	2	3	0	0	2	1	2
Total accidents	15	9	10	18	26	8	20	18	12	12
Number of people involved										
Serious injuries	1	1	0	0	3	2	0	1	2	2
Fatalities	0	3	2	2	6	0	0	2	1	3
Rate of aircraft involved										
Accidents per million departures	25	13.7	16	27.1	41.1	13.2	30.3	27.7	18.3	N/A
Fatal accidents per million departures	0	1.5	1.6	3	4.7	0	0	3.1	1.5	N/A
Accidents per million hours	31.6	18.8	21.1	33.4	50.7	17.2	39.8	37.5	24.1	N/A
Fatal accidents per million hours	0	2.1	2.1	3.7	5.8	0	0	4.2	2	N/A

Figure 12: Accident rate for charter aircraft (VH- registered) (per million departures), 2004 to 2012

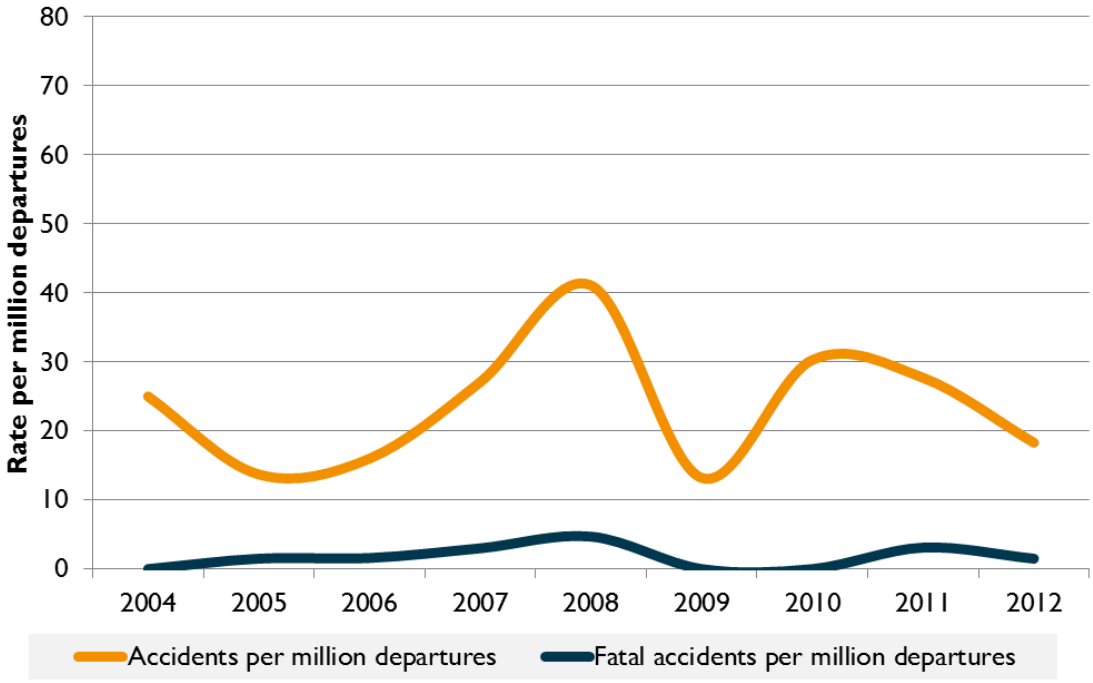
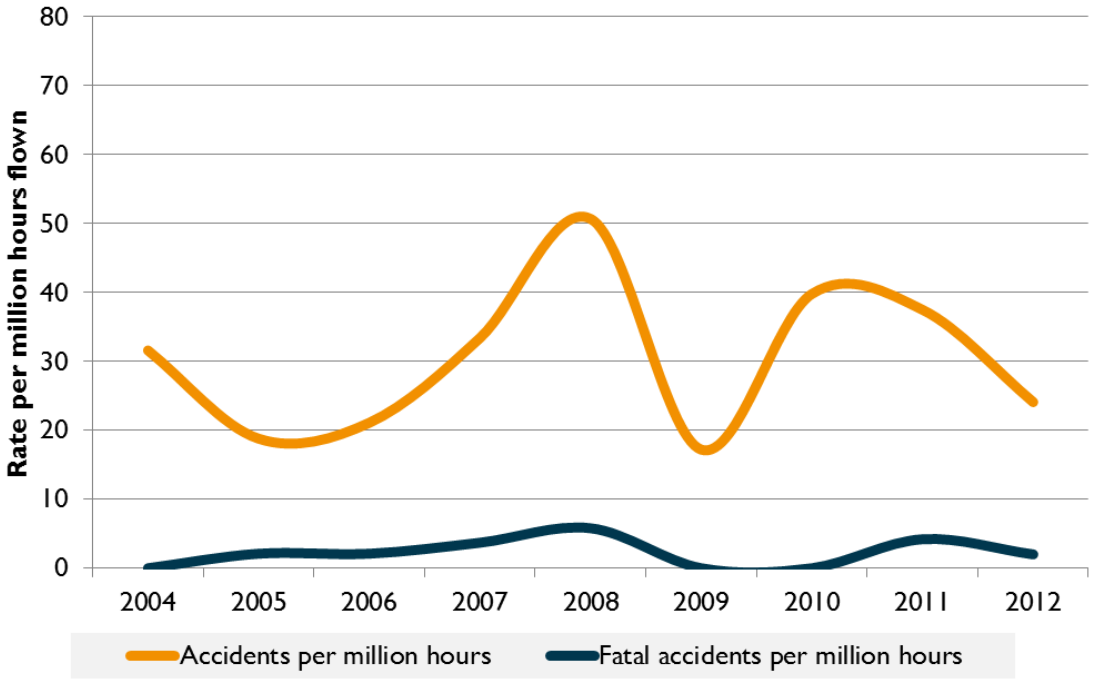


Figure 13: Accident rate for charter aircraft (VH- registered) (per million hours flown), 2004 to 2012



There were 34 VH- registered aircraft conducting charter work that were involved in accidents or serious incidents in 2013. Three of these resulted in serious or fatal injuries, and are described below:

- While preparing for a flight from Alice Springs, NT, a passenger suffered serious injuries as she was about to climb into the basket of a Kavanagh E260 hot air balloon. A long scarf she was wearing was drawn through the mesh guard of the cold air inflation fan that was being used to fill the balloon with air, and became entangled in the fan. The passenger later

succumbed to her injuries. Following this accident, the balloon operator modified their procedures relating to the movement of passengers in the vicinity of cold-air inflation fans and alerted their staff to the related hazards. The ATSB also released a Safety Advisory Notice to all hot air balloon operators to reassess their risk controls in relation to passenger proximity and securing of loose items when near cold air inflation fans. The ATSB is currently investigating this accident, focusing on the preparation of the balloon for flight, the actions of crew and passengers, and the regulatory framework affecting commercial balloon operations (ATSB investigation AO-2013-116).

Flight preparation event involving Kavanagh Balloons E260 (VH-FSR), near Alice Springs Airport, Northern Territory (ATSB investigation AO-2013-116)

- An Aerospatiale AS.350B Squirrel helicopter was one of two helicopters that departed from Davis Base, Antarctica to take scientists and field training officers to a penguin rookery at Cape Darnley, about 360 km to the west-northwest of Davis. Once the duties at the rookery had been completed, the helicopters departed on the return journey via the Amery ice shelf, where a fuel cache had been pre-positioned. After refuelling, the helicopters departed for Davis. On board the Squirrel were the pilot, a scientist, and one field training officer. While climbing through about 300 ft above mean sea level (AMSL), the pilots of both helicopters identified reduced surface definition and loss of visible horizon along their intended easterly flight path. After a brief discussion over the radio, the pilots elected to return to the fuel cache until the weather improved. The pilots reported that there was a visible horizon to the right of the easterly flight path, and commence a turn. While turning to the right, the Squirrel descended and impacted terrain. The helicopter was destroyed and all three occupants were injured. The pilot of the second helicopter observed the crash and landed near the accident site, commenced first aid to the crew of the Squirrel, and alerted personnel at Davis via satellite phone. Due to the deteriorating weather and the surrounding crevasse region, fixed-wing aircraft were unable to land at the accident site, and the crew and passengers from both helicopters remained on-site overnight. The following day, the pilot of the second helicopter flew two of the injured crew to Sansom Island, where they were transferred to an aeroplane for the flight to Davis. The helicopter then returned to the accident site to evacuate the remaining

patient to Davis. Due to their injuries, the pilot and passengers of the Squirrel were evacuated back to Hobart. The ATSB is currently investigating this accident, but the inaccessible nature and hazards associated with the location of the accident prohibited an examination of the wreckage. The investigation is focusing on procedures for Antarctic operations, meteorological conditions affecting the flight, crew and witness interviews, and aircraft documentation (ATSB investigation AO-2013-216).

- A de Havilland DH.82A Tiger Moth took off from Pimpama, Qld with a pilot and passenger on board to conduct a joy flight in the Gold Coast area. Shortly after the pilot commenced aerobatics, the aircraft's left wings failed and it descended steeply into the water about 300 m from the eastern shoreline of South Stradbroke Island. The aircraft was destroyed and both occupants fatally injured. Preliminary examination of the wreckage by the ATSB indicated that both of the aircraft's fuselage lateral tie rods (which join the lower wings to the fuselage) had fractured, despite a service life for these parts that was significantly less than the published retirement life for DH.82A tie rods. The fractures occurred at areas of significant, pre-existing fatigue cracking in the threaded section near the join with the left wing. The ongoing ATSB investigation will examine whether the failure of the fuselage lateral tie rods, or another mode of wing structural failure, was the initiator of the left wing separations. The ATSB has released a Safety Advisory Notice to all Tiger Moth operators, the Civil Aviation Safety Authority (CASA), the tie rod manufacturer, the New Zealand and United Kingdom aviation authorities advising of the premature failure of the tie rods in this accident (ATSB investigation AO-2013-226).

In-flight break-up involving de Havilland DH.82A Tiger Moth (VH-TSG), South Stradbroke Island, Queensland (ATSB investigation AO-2013-226)

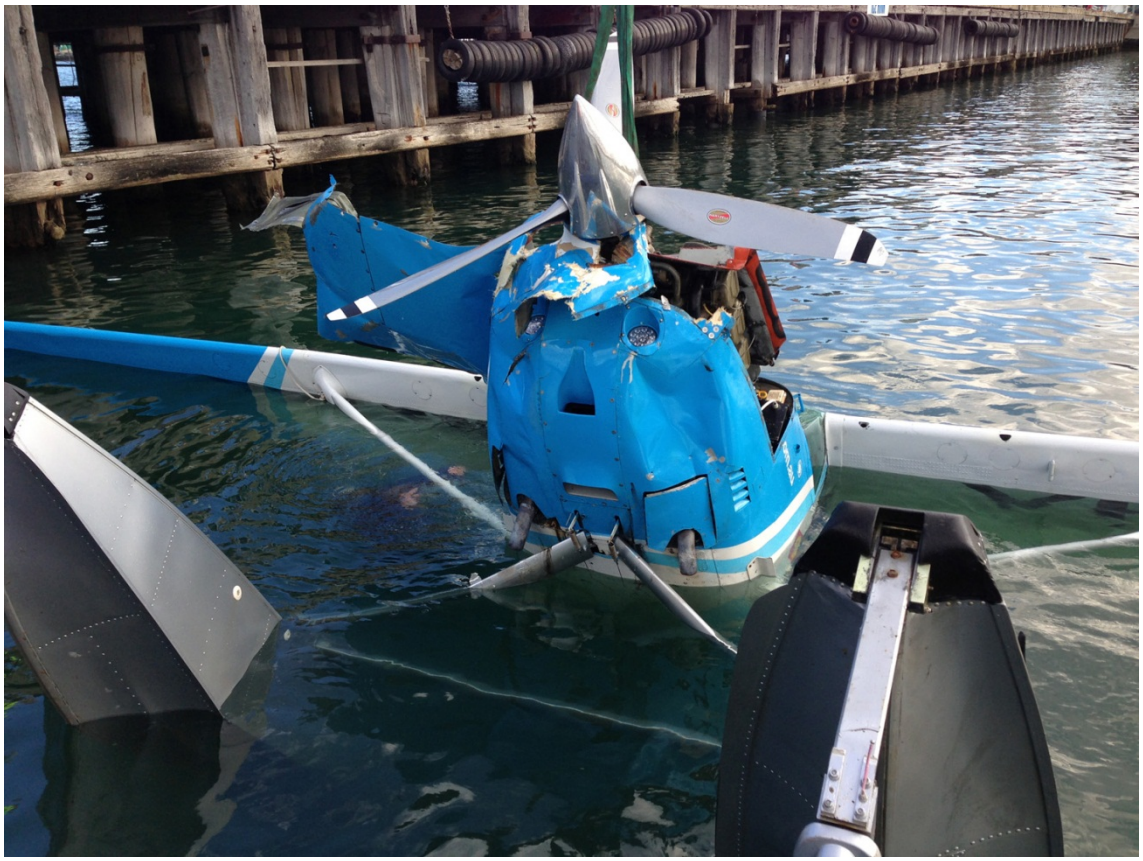
The remaining accidents and serious incidents most commonly involved wheels-up landings, and engine malfunction causing power loss and terrain collisions. There were also several serious incidents due to losses of separation near Moorabbin Airport, runway incursions, and landings at closed aerodromes.

Some notable accidents and serious incidents in 2013 involving charter operations are described below:

- A Cessna 182R took off from Kununurra Airport, WA on a charter flight with one passenger. When at about 100 ft above ground level, with insufficient runway distance remaining to abort the takeoff, the pilot retracted the landing gear. Immediately after, the engine failed. Due to the low altitude, the pilot confirmed that the engine controls were in the full forward position and that the fuel tank selector was on 'both'. The pilot then looked for a suitable place to land and saw a suitable field to the north. After extending the landing gear and selecting full flap, the main landing gear touched down in long grass and the aircraft decelerated rapidly. When the nose gear touched down, it dug into boggy ground and the aircraft flipped over, coming to rest inverted. The pilot and passenger received minor injuries and the aircraft sustained substantial damage. An engineering examination of the aircraft found no contaminates in the fuel or filters, and could not determine the reason for the engine failure (ATSB investigation AO-2013-023).

Engine failure involving a Cessna 182R Skylane (VH-OWZ), Kununurra Airport, Western Australia (ATSB investigation AO-2013-023)

- A Cessna U206F amphibious aircraft was conducting a seaplane joy flight from Corio Bay, Vic. with two passengers on board. During the flight the pilot refuelled the aircraft at Barwon Heads Airport, necessitating the use of the landing wheels. On the return trip, the pilot detoured for local sightseeing before heading back to Corio Bay for a water landing. On touchdown, the aircraft pitched over and came to rest inverted. The pilot assisted the two passengers to evacuate the aircraft before rescue vessels arrived. All three occupants sustained minor injuries, and the aircraft was substantially damaged. The ATSB investigation found that the pilot was distracted during the departure from Barwon Heads, and as a result did not retract the landing wheels during the after take-off checks. On returning to Corio Bay, the pilot shortened the approach due to perceived time pressure and did not complete the normal downwind and short final checks. In not completing those checks, the pilot reduced the likelihood of identifying that the landing wheels were still extended. The operator's requirement for passengers to wear life jackets throughout the flight enhanced the survivability of the passengers (ATSB investigation AO-2013-020).



Wheels-down water landing involving a Cessna U206F Stationair floatplane (VH-UBI), Corio Bay, Victoria (ATSB investigation AO-2013-020)

- A Cessna 337F Skymaster departed Onslow, WA on a 30 minute charter flight to Exmouth with three passengers. The front seat passenger and the pilot conversed for most of the flight. At about 5 NM on the final approach for runway 20, the pilot commenced pre-landing actions by extending the first stage of flap. The pilot later reported that this was where she normally lowered the landing gear, but could not recall why this step was missed. About 1 NM from landing, the pilot conducted the final pre-landing checks. Again, the pilot could not recall why she had not checked that the undercarriage was down as part of the final pre-landing checks. The pilot commenced the flare about 3 ft above the runway, and as the aircraft touched down on the bitumen, she realised that the undercarriage had not been selected down. The passengers and pilot exited the aircraft without injury. The fiberglass cargo pod fitted to the aircraft was damaged and the rear propeller contacted the ground, but the aircraft hull was undamaged. As a result of this occurrence, the pilot advised that from at least 5 NM final, she will ask the passengers not to speak to her, except to alert her to the presence of animals on the runway (ATSB investigation AO-2013-040).
- A Bell 206 LongRanger helicopter was conducting an aerial survey flight with four passengers in the Buccaneer Archipelago north of Derby, WA. The helicopter was being flown at about 1,000 ft to a planned fuel stop on an island in Cone Bay and was over water when the engine flamed out. The pilot entered autorotation to glide towards land but was unable to reach it. During the glide the pilot deployed the helicopter's pop-out floats in preparation for an emergency ditching. Shortly after touchdown the helicopter rolled inverted. The pilot and the four passengers exited without injury. A boat crew observed the emergency landing and rescued the occupants from on top of the upturned floating helicopter. The ATSB investigation found that without the pilot realising, the fuel on board was probably sufficiently low to allow momentary un-porting of the fuel boost pumps. This interrupted the flow of fuel to the engine, resulting in an engine flame-out and ditching. Contributing to the pilot's lack of awareness of the fuel state was a likely malfunction of the helicopter's fuel quantity indicating system and a

faulty low fuel caution system. In addition, the operator's fuel management system was almost totally reliant on the fuel quantity indicating system and as a consequence, lacked a high level of assurance. The ATSB also found that the guidance provided by CASA in relation to pre-flight cross-checking of fuel on board allowed for a reliance on aircraft fuel quantity indicating systems without reference to independent sources of fuel quantity information (ATSB investigation AO-2013-097).

- About two hours after last light, an Alliance Airlines Fokker 100 was taxiing for a charter flight from Williamtown, NSW. As the captain taxied the aircraft onto the runway, ATC cleared the aircraft for take-off. The captain then momentarily looked down to confirm that the correct departure heading had been entered into the aircraft's flight management system. As he looked up, he believed he had almost overshot the runway centreline as he observed the threshold markings in front and under the nose of the aircraft, and a line of recessed lights to his left. The captain determined that the recessed lights were runway centreline lights. Shortly after, the captain commenced the take-off run. Immediately after, the captain noted that the ground area to the left of the runway centreline lights ahead was a different colour than that on the right. He then realised that he had lined up on the runway edge lights. The captain rejected the take-off and steered the aircraft to the right, toward the actual runway centreline. A review by the operator found that the design of the recessed lighting and obscured centreline markings at Williamtown for the purposes of military operational readiness caused visual confusion for pilots, which was compounded in this serious incident by an unserviceable aircraft taxi light. There was also distraction caused by the requirement for the crew to enter the heading issued by ATC as part of the departure instructions at a critical time. The Department of Defence has repainted runway centreline and taxiway lead-in markings to improve visibility, and the operator released a notice to flight crews about the hazards of take-off misalignments and to increase awareness of obscured markings and lights at military airports. The ATSB has published a research report identifying eight factors common to misaligned take-offs at night, and developed a pilot information card to assist crews in identifying factors that increase the risk of a misaligned take-off (ATSB investigation AO-2013-133).
- A Bell 206L helicopter was conducting passenger ferry operations between Olympic Park and Flemington racecourse in Melbourne. Prior to the accident, the pilot was preparing to reposition the helicopter from one of the temporary helipads on the western side of the oval to a position that would allow the helicopter to depart for the racecourse. As the pilot began to lift the helicopter into a hover, witnesses observed the helicopter commencing to roll about the right skid. In rapid succession the left skid continued to rise and the helicopter rolled further right until the helicopter's main rotor blades contacted the ground. A large amount of high energy debris was released from the helicopter and impacted a nearby marquee and vehicles, including the helicopter on the adjacent helipad. The helicopter was extensively damaged, but no bystanders or persons in the cars or marquee were injured. The pilot sustained minor injuries and was able to exit the wreckage. The ATSB is currently investigating this accident and will be reviewing the planning of the charter operation, including the consideration of public safety. In the interim, the ATSB advises owners, operators and pilots of aircraft involved in public events to review their operations to assure themselves that existing risk controls address the hazards associated with operating aircraft in such environments (ATSB investigation AO-2013-199).

Collision with terrain involving a Bell 206L helicopter (VH-VDZ), Melbourne, Victoria (ATSB investigation AO-2013-199) – picture shows right roll and main rotor ground strike

Foreign-registered air transport

In the last 10 years, no foreign-registered air transport aircraft operating in Australia have been involved in fatal or serious injury accidents (Table 8).

Table 8: Occurrences involving foreign-registered air transport aircraft in Australia, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	171	180	146	137	131	120	143	159	158	182
Serious incidents	1	7	1	5	3	1	1	1	3	1
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	0	0	1	0	0	1	0	0	1	0
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	0	0	0	0	0	0

There was one serious incident involving a foreign-registered air transport aircraft in Australia in 2013:

- An United Arab Emirates-registered Airbus A330 was departing Brisbane Airport for a flight to Singapore when the captain rejected the takeoff after observing an airspeed indication failure on his display. The maximum airspeed recorded by the flight data recorder during the rejected takeoff was 88 kts. The aircraft was taxied back to the terminal for troubleshooting, where two of the three air data inertial reference units (ADIRUs) were transposed. The aircraft was again dispatched, but with the air data reference part of ADIRU 2 inoperative in accordance with the

minimum equipment list (MEL). The first officer's data source was switched from ADIRU 2 to ADIRU 3 (which was left in its original position), while the captain's data source remained switched to ADIRU 1. During the second takeoff attempt, the crew became an awareness of an airspeed discrepancy after the aircraft had reached V1, and the crew continued the take-off. Once airborne, a MAYDAY was declared and the aircraft returned to Brisbane to make an overweight landing. Subsequently the aircraft's pitot probes (which measure airspeed information that is sent to the ADIRUs) were visually inspected, and it was found that the captain's probe was almost completely blocked by a mud dauber wasp's nest. The first officer's and standby pitot probes were found to be clear of blockages. A similar incident to this occurred at Brisbane Airport in 2006, where an aircraft's pitot probe was blocked by an insect nest. The ATSB investigation is currently underway and will analyse recorded data from the aircraft, aircraft systems, flight operations and maintenance/troubleshooting aspects (ATSB investigation AO-2013-212).

General aviation

General aviation is considered to be all flying activities outside of scheduled (RPT) and non-scheduled (charter) passenger and freight commercial air transport operations. It also excludes recreational aircraft that are administered by RAAOs and do not have an Australian civil (VH-) registration, such as recreational aeroplanes up to 600 kg, weight shift hang gliders, paragliders, powered parachutes and trikes, and gyrocopters. These aircraft are reported on separately in these statistics.

General aviation is further broken down into aerial work (ambulance and emergency medical services, agriculture, mustering, search and rescue, fire control, and survey and photography), flying training, and private/business and sports aviation (see *Appendix A – Explanatory notes*).

Conservative estimates place at least 90 per cent of the Australian VH- registered aircraft fleet into the category of general aviation. General aviation also accounts for over half of all aircraft movements across Australia (see Figure 1 on page 4). In comparison, large air transport aircraft operated by major airlines make up less than three per cent of Australian-registered aircraft. General aviation aircraft also make up about 40 per cent of the total hours flown by Australian-registered aircraft (as shown in Figure 3 on page 6).

Despite the larger size of general aviation compared to air transport in both fleet size and number of departures, there are comparatively few occurrence reports sent to the ATSB involving general aviation aircraft. In 2013, there were 1,811 GA aircraft involved in 1,664 occurrences reported to the ATSB (representing about a quarter of GA aircraft on the VH- register) (Table 9). Although there is a less comprehensive reporting requirement for aircraft not engaged in commercial air transport, the reporting rate is small when compared to 4,324 commercial air transport aircraft involved in 4,206 occurrences in 2013 (multiple occurrences on average for each air transport aircraft on the VH- register).

Table 9: All general aviation occurrences (VH- and foreign registered aircraft), 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	1,403	1,648	1,754	1,689	1,729	1,919	1,650	1,620	1,543	1,529
Serious incidents	74	57	70	95	108	98	135	138	166	189
Serious injury accidents	14	4	8	7	16	10	15	12	8	6
Fatal accidents	12	16	19	12	22	16	13	16	20	15
Total accidents	143	118	91	118	126	120	128	114	103	93
Number of people involved										
Serious injuries	21	5	13	9	23	13	19	21	11	7
Fatalities	24	21	34	21	34	16	16	28	29	24
Rate of aircraft involved[13]										
Accidents per million departures	71.9	52.2	49.7	65.2	63.8	65.2	62.7	60.7	56.6	
Fatal accidents per million departures	5.6	7.1	10.5	6.7	11.2	8.7	6	8.6	11.3	
Accidents per million hours	122.3	95.3	74.1	91.1	93.5	89.8	93.4	88	83.3	
Fatal accidents per million hours	9.5	12.9	15.6	9.3	16.5	12	9	12.5	16.7	

A major challenge for the ATSB in its charter to improve transport safety is that there is a lower level of awareness in the general aviation community of the need to report safety matters, and what constitutes a reportable transport safety matter. Under-reporting of safety matters has been identified as one of the ATSB's *SafetyWatch* priorities for improving transport safety in Australia. Future amendments to the Transport Safety Investigation Regulations intend to clarify what industry needs to report, in order to make reporting clearer and less onerous for pilots and operators alike. It is hoped that these changes, along with improved engagement with the general aviation community by the ATSB (through programs such as the popular *Avoidable Accidents* series) will help to reduce underreporting of incidents.

Aircraft conducting aerial work (EMS operations in particular) and flying training tended to report more occurrences, or were individually associated with more occurrence reports. While this could suggest that certain general aviation operations involve a greater level of risk, it is more likely that the reporting cultures and safety management systems of the operators involved in these types of flying is stronger than in other areas of general aviation. In a large proportion of reported general aviation occurrences (813 incidents, 43 serious incidents and five accidents in 2013), the type of flying that the aircraft was involved in (and in about one-quarter of incidents, whether the aircraft was VH- registered or not) was not reported to the ATSB. In these occurrences, the ATSB was notified by someone other than the pilot(s) of the aircraft involved (such as air traffic control, the public, pilots of nearby aircraft, or aerodrome-based staff). A review of 'unknown' general aviation occurrences found that most were associated with:

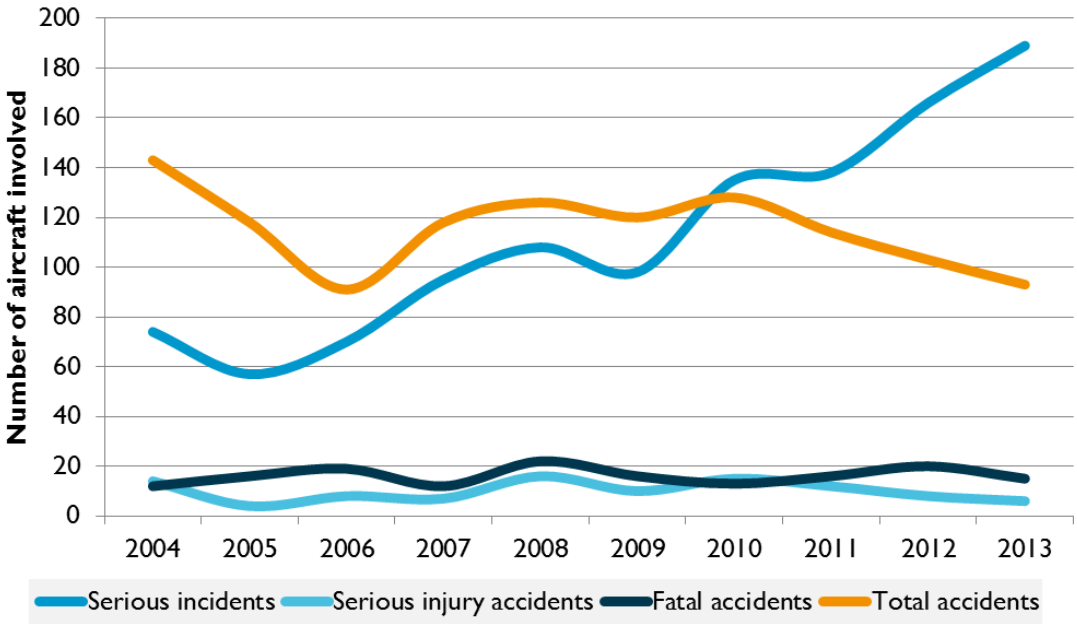
- airspace infringement, or operational non-compliance with published aeronautical information or other regulations) that led to an aircraft proximity issue
- ground operation-related occurrences

[13] Foreign registered general aviation departures and hours are not known. VH- registered aircraft hours are used as a proxy denominator. The real rate per departure or hour will be slightly smaller than the figures presented in this table. This equates to nine accidents over the period between 2004 and 2013 (including two fatal accidents) where aircraft hours are not known and are not included in the denominator figures.

- bird and animal strikes.

While the number of GA aircraft involved in incidents has fallen for the last 5 years, Figure 14 shows that the number of serious incidents has increased. While the rate of accidents has fallen over this time period as shown in Figure 15, the rate of fatal accidents has increased.

Figure 14: General aviation occurrences and injuries (VH- and foreign registered aircraft), 2004 to 2013



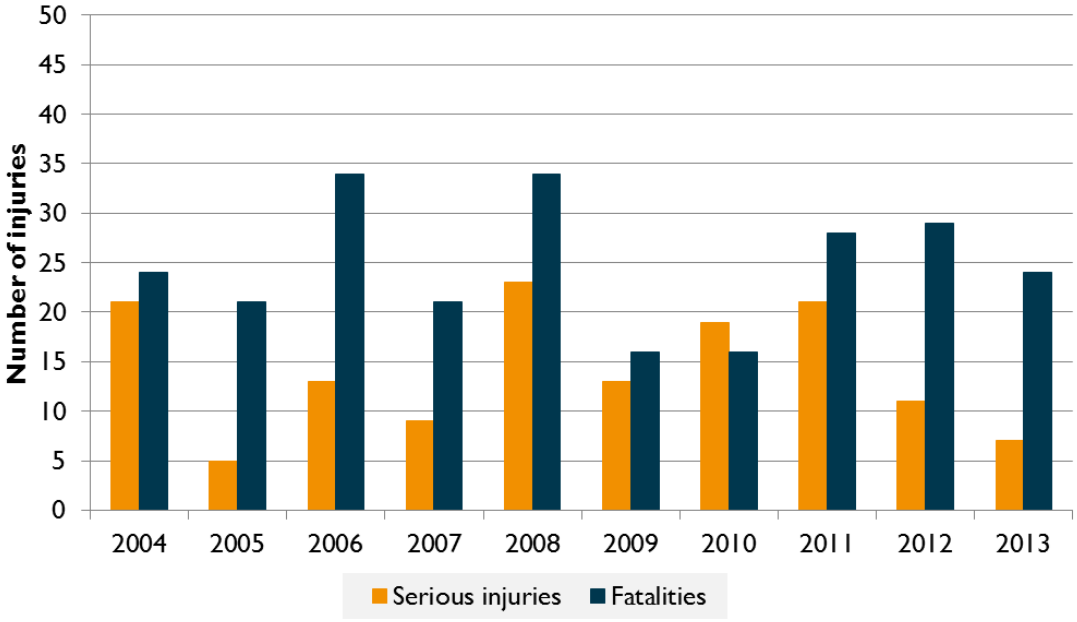
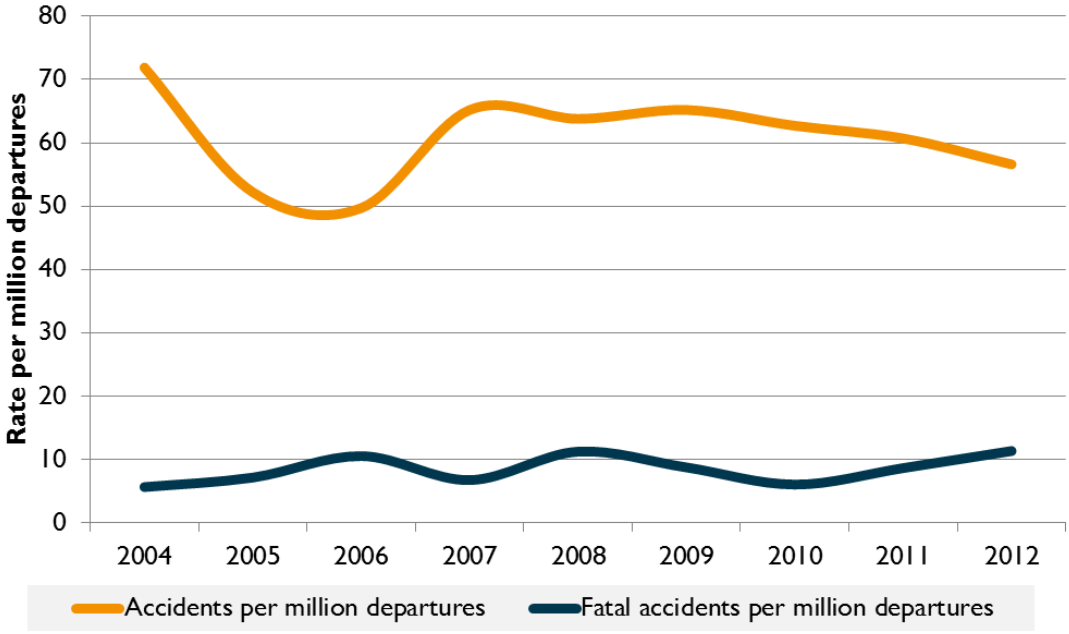


Figure 15: General aviation accident and fatal accident rate (per million departures, VH- registered aircraft only), 2004 to 2012



Of the 1,154 general aviation aircraft involved in accidents between 2004 and 2013, more than 1 in 10 were fatal accidents, with 247 lives lost. In the most recent year where departures information was available (2012), the accident rate per million departures was almost six times as large in GA as in commercial air transport[14], although the rate for GA showed a decrease compared to previous years. The fatal accident rate in GA increased in 2012 despite the accident rate decreasing over several years.

Accident types and severity varies across different types of general aviation flying, as some types of operations involve a greater level of accepted operational risk (like low flying in aerial agriculture and mustering). Over the 2004 to 2012 period, per million hours flown:

- Emergency medical services had the lowest fatal accident rate (1.4 per million hours flown) and the lowest accident rate (6.8 per million hours flown).
- Flying training also had a low fatal accident rate (2.1 per million hours flown), although the accident rate was notably higher (40.5 per million hours flown).
- Aerial mustering showed a similar trend to flying training, with a low fatal accident rate (5 per million hours flown) and a higher accident rate (57.6 per million hours flown).
- Survey and photographic flights had a fatal accident rate (15.8 per million hours flown) that was slightly above the GA average (12.6 per million hours flown), but a lower accident rate compared to average (58.7 versus 91.1 per million hours flown).
- Aerial agriculture had the highest accident rate of all types of GA flying (173.3 per million hours flown), and a fatal accident rate that was almost twice the GA average (21.3 per million hours flown).
- Private/business/sport flying (not including gliding) had the highest fatal accident rate of all types of GA flying (24.1 per million hours flown), higher than GA operation types such as aerial agriculture and aerial mustering which inherently involve greater risk. The accident rate (155.2

[14] There have been very few fatal accidents involving commercial air transport in Australia in recent times. Over the 10 years ending 2013, there were 14 air transport aircraft involved in fatal accidents (mostly involving charter operations). The most serious fatal accident during this time was the Lockhart River accident in 2005, in which 15 people died.

per million hours flown) was significantly above the GA average, and was below only aerial agriculture.

- Gliding, relative to private and sport aviation, had a relatively low fatal accident rate (8.7 per million hours) and accident rate (36.3 per million hours).

Aerial work

Aerial work is made up of a number of different commercial activities, including aerial agriculture, mustering, surveying and photography, emergency medical services, search and rescue, check and training flights, and aerial fire control. Some of these activities require aircraft to regularly operate in conditions with inherent risks, such as manoeuvring at low level (crop spraying and aerial mustering), which should be considered when comparing aerial work occurrence data with that of other operation types.

While there was a large variation in the number of VH-registered aircraft involved in aerial work that had accidents per year over the last 10 years, the number of accidents in 2013 (20) was one of the lowest (Table 10). This was supported by a halving of the accident rate and a three-fold reduction in the fatal accident rate in aerial work operations between 2010 and 2012 (Figure 16). The low number of accidents involving aerial work aircraft in 2013 was particularly due to fewer accidents in commercial aerial mustering, although there were more accidents in survey and photography, EMS, and fire control operations.

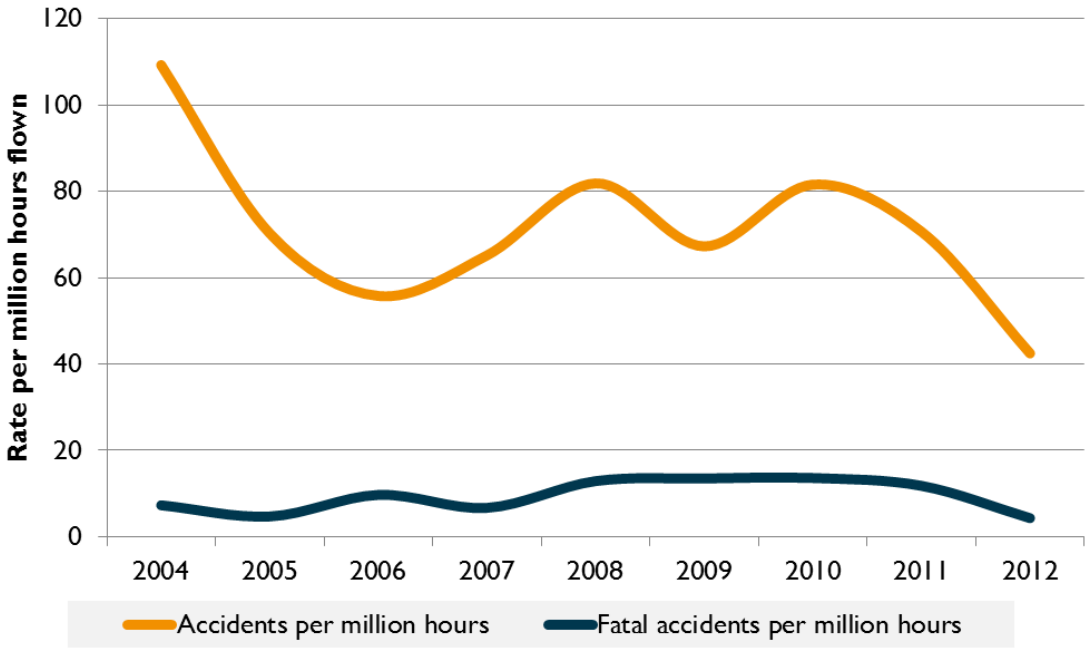
The number of aerial work aircraft involved in serious incidents in 2013 (49) was the highest in the last 10 years, and represented a 30 per cent increase compared to 2012. This was due to more aerial agriculture serious incidents (which almost doubled between 2012 and 2013, although the number of accidents fell).

The number of aerial work aircraft involved in incidents increased by more than 50 per cent between 2004 and 2013. This increase was primarily due to more reports from EMS and survey and photography operators. In 2013, aerial agriculture was exclusive among aviation operation types in Australia in that significantly more serious incidents were reported than incidents.

Table 10: Aerial work (VH- registered aircraft) occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	181	210	210	196	212	244	212	242	257	263
Serious incidents	15	15	10	14	18	16	31	24	38	49
Serious injury accidents	6	2	2	2	7	3	5	5	2	1
Fatal accidents	3	2	4	3	6	6	7	6	2	3
Total accidents	45	30	23	29	38	30	42	36	20	20
Number of people involved										
Serious injuries	9	2	2	2	9	5	6	8	2	1
Fatalities	4	2	9	3	7	6	8	9	2	3
Rate of aircraft involved										
Accidents per million hours	109.3	70.3	55.8	65.2	81.9	67.3	81.6	70.7	42.5	N/A
Fatal accidents per million hours	7.3	4.7	9.7	6.7	12.9	13.5	13.6	11.8	4.3	N/A

Figure 16: Accident rate for aircraft (VH- registered) involved in aerial work (per million hours flown), 2004 to 2012



Accidents, serious incidents, and injuries that occurred in 2013 in the different types of aerial work are explored in the following sections.

Aerial agriculture

There were 306 aircraft conducting aerial agriculture that were involved in occurrences reported to the ATSB between 2004 and 2013, with a notable increase in serious incidents in 2013 (Table 11). About 45 per cent of occurrences over this period were accidents, including 17 accidents that resulted in fatalities and 14 where serious injuries occurred. Despite the increase in serious incidents, the number of accidents in 2013 involving aerial agriculture aircraft decreased, as did the number of fatal accidents.

Table 11: Occurrences involving general aviation aircraft conducting aerial agriculture, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	6	4	1	4	5	5	2	7	6	9
Serious incidents	9	9	3	5	7	5	17	13	15	27
Serious injury accidents	4	1	1	1	4	0	0	3	0	0
Fatal accidents	1	1	1	0	3	3	4	1	2	1
Total accidents	22	18	8	10	18	10	16	18	10	8
Number of people involved										
Serious injuries	4	1	1	1	4	0	0	3	0	0
Fatalities	1	1	1	0	3	3	4	1	2	1
Rate of aircraft involved										
Accidents per million hours	254.4	189.5	129.6	161	230.2	136.5	154.2	179.3	112.3	N/A
Fatal accidents per million hours	11.6	10.5	16.2	0	38.4	40.9	38.5	10	22.5	N/A

The eight aerial agriculture aircraft involved in accidents in 2013 are described below. Many of these accidents were wirestrikes:

- An Ayres S2R Thrush struck power lines while conducting aerial spraying near Condobolin, NSW. The pilot was uninjured, but the aircraft was substantially damaged. The pilot was carrying out the final clean-up run before returning to the airstrip. The pilot was flying from west to east, parallel to the main power line, which was located beside the field, outside of the area being sprayed. Another smaller power line with three wires ran diagonally across the field from the main power line. Once the pilot had run out of product, he pulled up to gain altitude, when he struck the smaller power line that ran diagonally across the field. Two of the wires were cut by the aircraft's wire protection system and the third wrapped around the propeller hub arresting the aircraft and pulling it around in a half circle where it came to rest on the ground. As a result of this accident, the electricity distribution company is installing a marking system on the power line (ATSB investigation AO-2013-033).
- A Robinson R44 helicopter was engaged in agricultural operations in a paddock near Clarks Hill, Vic. As the helicopter approached the paddock from the south at 50 kt and at spray height, the pilot remembered a wire that extended halfway across the southern boundary of the paddock to a pump house. The pilot judged that it was too late to attempt to pull up over the wire and attempted to avoid the wire by flying underneath it. The vertical stabiliser contacted the wire and the tail rotor gearbox separated from the tail boom. The pilot was able to exit the helicopter with minor injuries, however, the helicopter was substantially damaged (ATSB investigation AO-2013-042).

Wirestrike involving a Robinson R44 helicopter (VH-HGF), near Ballarat, Victoria (ATSB investigation AO-2013-042)

- An Enstrom 480B helicopter was engaged in aerial spraying near Trinda, Vic. During the application run to spray the final load of chemical to the paddock, the Global Positioning System (GPS) lost reception. The pilot immediately aborted the run and climbed to about 400 ft above ground level and attempted to resolve the issue with the GPS. Once the GPS regained

reception, the pilot commenced a left turn at about 50 kt indicated airspeed to return to the paddock and recommence the application run. The pilot then heard a loud bang and felt a shudder through the airframe as the helicopter struck a wire. The pilot performed a run-on landing in the nearest clearing but had difficulty in maintaining yaw control because the tail rotor control cables had lost tension. The pilot was able to exit the helicopter without injury, however, the helicopter was substantially damaged. The ATSB was advised by the owner of the wire that it was marked with five marker discs, however, the pilot advised that the wire was unmarked at the time of the wirestrike. The ATSB investigation was unable to independently confirm that the maker discs were still in place at the time of the wirestrike. As a result of this accident, the wire was replaced and arrangements are being made to install markers on the line (ATSB investigation AO-2013-031).

Wirestrike involving an Enstrom 480B helicopter (VH-VDC), near Ballarat, Victoria (ATSB investigation AO-2013-031)

- The pilot of an Air Tractor AT-502 was preparing to conduct aerial spraying on a property near Temora, NSW. The owner of the property had provided the pilot with a map of the area to be sprayed, which included power lines. There was a road and a row of trees to the south of the

paddock, with double power lines (marked on the map) about 130 m north of the tree-line. The pilot planned to fly over the trees and under the power lines on each leg, before turning to commence the next run. When the Air Tractor was south of the paddock at about 15 to 20 ft AGL, after turning to commence the next run, the pilot saw a cross arm indicating the presence of a wire attached to a derelict homestead. He decided not to climb the aircraft as it would have collided with the larger double power lines. The pilot then heard a bang, with the aircraft's propeller spinner contacting the wire. The pilot flew the aircraft under the double power lines and climbed to about 150 ft AGL. The engine was vibrating and then steadily lost power. The pilot secured the engine and conducted a forced landing in a paddock, during which the Air Tractor ground-looped and the left wing contacted the ground. The aircraft was substantially damaged but the pilot was not injured. The pilot reported to the ATSB that he did not see the wire at any stage, nor was it marked on the map provided to the pilot by the property owner (ATSB investigation AO-2013-180).

Wirestrike involving an Air Tractor AT-502 (VH-CJY), near Temora, New South Wales (ATSB investigation AO-2013-180)

- An Ayres S2R Thrush was conducting crop spraying in company with a second aircraft on a property near Hyden, WA. The application flights were assisted by loaders who mixed the required chemical prior to its loading into the respective aircraft, and remained at a refilling station next to a temporary airstrip on the property. The pilot had completed 14 spray runs that morning before stopping for lunch while the aircraft was refuelled and loaded with chemical prior to the recommencement of operations. About 45 minutes after the Thrush took off, the loaders and second pilot became concerned that the aircraft had not returned and initiated a search. The aircraft was found by the second pilot in a lightly wooded area about 1,700 m from the refilling station, and the pilot was fatally injured. The ATSB found that the aircraft departed controlled flight from which the pilot was unable to recover, leading to the collision with terrain. On the basis of the available evidence, it was not possible to determine the reasons for the loss of control. The ATSB identified two aspects of the aircraft's operation which had the potential to adversely affect safety. These were the use of an unapproved fuel mix and the

operation of the aircraft above its published maximum take-off weight (ATSB investigation AO-2013-183).

- An Air Tractor AT-502 was conducting rice sowing at a property near Deniliquin, NSW. The pilot was conducting his fourth landing of the day onto the property's airstrip. During the landing, the main wheels touched down first, followed by the tail, which was locked into place. Shortly after, the aircraft suddenly veered right about 45°. The pilot considered a go-around, but was concerned that the aircraft would not clear the boundary fence running along the side of the runway. Consequently, he elected to continue the landing and selected reverse thrust, applied left brake, left rudder and left aileron in an attempt to re-align the aircraft with the runway. The wheels began to grab and the left undercarriage leg detached, causing the aircraft to swing facing about 90° from the runway. The pilot was not injured, but the aircraft was substantially damaged. The ATSB investigation could not determine what led to the loss of ground control, however, a wind gust may have been a contributing factor (ATSB investigation AO-2013-188).
- The pilot of a Robinson R44 helicopter had completed a full day of aerial spraying work near Cootamundra, NSW, after which he reported feeling dehydrated and tired from the time pressures involved with the operation. He then attended a briefing for the next day's operations, which involved aerial spraying of weeds on three properties. The briefing specified the areas to be sprayed; however, no maps or detailed information regarding the operation were provided to the pilot. The next day, due to a series of delays, operations commenced later than expected. The pilot reported feeling time pressured and frustrated at the inadequacy of the preparations. After completing five loads of spraying, the pilot elected to land the helicopter to discuss the remaining areas to be sprayed with the land owner. He was reminded of a rocky gully with blackberries that needed to be sprayed, which was away from the area he had been working on earlier. He did not recall that gully being mentioned at the briefing and he was not alerted to the existence of any power lines. Before commencing spraying of the gully, the pilot overflew the gully but did not observe any power lines or power poles. During the spraying, which required looking out of the helicopter window and door towards the ground, he sighted power lines just as the helicopter main rotor disc struck the wires. He immediately conducted a precautionary landing. The helicopter sustained substantial damage to the main rotor blades but the pilot was uninjured (ATSB investigation AO-2013-227)
- A Grumman G-164 took off from an airstrip near Deniliquin, NSW to conduct aerial spraying spreading operations. The pilot reported applying a higher power setting than normal for take-off as it was a warm day and the airstrip was short. When at about 150 ft AGL, the pilot levelled the aircraft off and commenced a turn, during which the pilot felt the aircraft sink. The pilot rolled the wings level and elected not to jettison the chemical fertiliser load because the aircraft normally stopped sinking once the wings were level. However, the aircraft continued to sink and the pilot then jettisoned the load. When at about 20 to 30 ft AGL, with a nose high attitude, the pilot felt the aircraft's wings shaking, indicating an imminent stall. The pilot increased engine power in an attempt to avert the stall, but the aircraft continued to descend. Shortly after, the wheels touched down in a rice paddy in about 20 cm of water and the aircraft flipped over. The aircraft was substantially damaged but the pilot was uninjured (ATSB investigation AO-2014-001).

Although there were fewer accidents reported in aerial agriculture in 2013 when compared to previous years, the number of serious incidents doubled when compared to 2012 and was the highest in 10 years. The majority of these serious incidents (22 of 27) occurred when the aircraft contacted an obstacle (such as a wire or a tree), but was able to continue operating. There were two serious incidents that were investigated by the ATSB:

- Two aircraft were conducting aerial spraying operations from a privately owned airstrip. The fire-bombing door of one aircraft had unexpectedly released during taxi and the 2,700 L load was jettisoned onto the ground, contaminating the runway. As the other aircraft was landing and approaching the runway end, the pilot observed mud spraying up from the aircraft's

wheels. The aircraft then commenced sliding and turning to the left. When the left wheel contacted dry ground, the aircraft swung further left and tipped forward, resulting in the propeller contacting the ground. The aircraft then tipped backwards and the tail wheel assembly detached (ATSB investigation AO-2013-043).

- An Ayres S2R Thursh was conducting aerial spreading operations on a property near Horsham, Vic. At about the same time, the operator of a remotely piloted aircraft (RPA) arrived at the Echo Mine site to conduct an aerial photography survey. He heard the pilot of the Thrush operating about 1 to 1.5 km away, and broadcast on the area frequency advising his intention to conduct RPA aerial photography operations but did not receive a response. He asked the mine manager to contact the farmer and notify the pilot. The RPA operator then commenced his flight at about 390 ft AGL. After the Thrush pilot had completed spreading the first load of fertiliser, the farmer informed the pilot that there would be an 'aircraft' conducting aerial photography over the Echo Mine. The pilot assumed this would be a fixed-wing aircraft operating at or above 500 ft AGL, and intended to remain at or below 350 ft AGL to ensure separation. Shortly afterwards, the RPA operator heard the Thursh and observed it turning about 150 m north of the RPA before it departed to the north. The operator immediately put the RPA into a holding pattern to maintain its current position, estimating that the Thrush was flying at about 100-150 ft AGL and came within about 100 m horizontally of the RPA. He attempted to contact the pilot of the Thrush on the radio but did not receive a response. The pilot of the Thrush reported operating at about 50-100 ft AGL on a block just north of the mine site, and did not see the RPA (ATSB investigation AO-2013-167).

In 2012 (the last year for which flying activity data was available at the time of writing), aerial agriculture operations recorded the lowest accident rate (112.3 per million hours flown) of any year since 2004. This accident rate was the second highest of all types of GA operations in 2012.

The high accident rate, and common nature of many accidents and serious incidents (wirestrikes, collisions with ground objects, and control problems at low altitude) should be a reminder to pilots conducting spraying and other types of aerial agricultural operations that pre-flight planning and risk assessments are important to identify hazards in operating and manoeuvring areas. Improper loading of chemical tanks and hoppers can cause aircraft stability and control problems, especially when manoeuvring, or if the aircraft is affected by windshear or gusts.

Aerial mustering

As with aerial agriculture, the number of commercial aerial mustering incidents reported to the ATSB each year is small. However, the number of accidents and serious incidents is generally lower. In the 10 years ending 2013, there were 59 aircraft involved in aerial mustering that had accidents, and 14 involved in fatal or serious injury accidents (Table 12).[15]

Over the same period, only four aerial mustering incidents and eight serious incidents were reported to the ATSB. When compared to general aviation as a whole (where there were more than 30 incidents or serious incidents reported for every accident that occurred over the last 10 years), the low number of incidents recorded each year suggests that they are significantly under-reported by aerial mustering operators.

[15] In addition to the commercial aerial mustering accidents reported in Table 12, between 2004 and 2013 there were also 11 accidents (seven of which were fatal), but no serious incidents involving private (not for reward) aerial mustering. These accidents are reported under *Private/business* on page 60.

Table 12: Occurrences involving general aviation aircraft conducting aerial mustering, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	0	1	0	1	0	1	0	1	0	0
Serious incidents	0	1	1	0	1	0	2	1	0	2
Serious injury accidents	1	0	0	1	1	0	4	1	1	0
Fatal accidents	0	0	0	1	0	2	1	1	0	0
Total accidents	7	5	4	8	3	5	14	6	6	1
Number of people involved										
Serious injuries	1	0	0	1	1	0	4	1	1	0
Fatalities	0	0	0	1	0	2	1	1	0	0
Rate of aircraft involved										
Accidents per million hours	67.8	44.2	39	70.9	26.6	47.4	118.6	47.7	53.3	N/A
Fatal accidents per million hours	0	0	0	8.9	0	18.9	8.5	7.9	0	N/A

In 2013, there were three aerial mustering aircraft involved in accidents or serious incidents that were reported to the ATSB. The number of accidents in 2013 showed a large decrease from 2012, and was the lowest number in the last 10 years. None involved injuries to the aircraft occupants:

- A Robinson R22 helicopter was being used for mustering cattle on a property about 155 km from Normanton, Qld. As the helicopter was hovering behind a herd of cattle, the pilot felt the helicopter jerking. Suspecting an ignition system problem, he landed and checked the magnetos. On selecting the left magneto, the engine rapidly lost power, whereas the engine ran normally on selecting the right magneto. He reselected the magneto switch to 'BOTH' and attempted to contact the property manager. Unable to make contact with the manager, the pilot elected to take-off, and once airborne was able to communicate with the manager via UHF radio. He turned the helicopter towards a road and commenced an approach to land on the road. At about 20 ft AGL, the engine stopped. The pilot lowered the collective and flared the helicopter for landing. On impact, the helicopter spun around 180° and was substantially damaged, but the pilot was not injured. An engineering inspection of the left magneto revealed that a loose distributor bushing and play in the plastic gear wheel resulted in the magneto providing the ignition spark to an incorrect engine cylinder at the wrong time (ATSB investigation AO-2013-211).

Total power loss involving a Robinson R22 helicopter (VH-STK), 155 km south-west of Normanton, Queensland (ATSB investigation AO-2013-211)

The two serious incidents below were not investigated by the ATSB:

- During aerial mustering operations near Chillagoe, Qld, the Robinson R22 helicopter tail rotor struck a tree resulting in minor damage (ATSB occurrence 201310629).
- During aerial mustering operations near Delta Downs, Qld, the tail rotor of the Robinson R22 struck a tree stump causing minor damage (ATSB occurrence 201311026).

Emergency medical services (EMS)

Occurrences reported to the ATSB involving EMS aircraft make up the second largest proportion of GA occurrences behind *Private/business* aviation. The number of incidents reported to the ATSB in 2013 fell after several years of increase, although the number reported was the second highest in the last 10 years (Table 13).

Of all types of aerial work where information on flying activity is recorded, EMS operations had the lowest accident rate. This is in spite of the sometimes higher safety risks faced by EMS aircraft and flight crews when approaching and landing at remote or hazardous places to rescue people or provide medical relief.

The high number of incidents reported to the ATSB involving EMS aircraft relative to the number of accidents and serious incidents suggests there is a strong safety reporting culture in EMS operations compared to other types of aerial work.

Table 13: Occurrences involving general aviation aircraft conducting emergency medical services (EMS) operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	87	103	103	94	122	124	101	116	151	137
Serious incidents	1	1	0	2	5	3	3	1	7	7
Serious injury accidents	0	0	0	0	0	2	0	0	0	0
Fatal accidents	0	0	0	0	0	0	0	1	0	1
Total accidents	0	0	0	1	0	3	0	1	0	2
Number of people involved										
Serious injuries	0	0	0	0	0	3	0	0	0	0
Fatalities	0	0	0	0	0	0	0	1	0	1
Rate of aircraft involved										
Accidents per million hours	0	0	0	13.4	0	36.8	0	11.3	0	N/A
Fatal accidents per million hours	0	0	0	0	0	0	0	11.3	0	N/A

In 2013 there were two accidents and seven serious incidents reported to the ATSB involving EMS aircraft. Most of these were subject to an investigation by the ATSB:

- A Beech King Air on an aeromedical retrieval flight from Sydney was inbound to Griffith, NSW. When 25 NM east of Griffith, the pilot broadcast his position and intentions on the CTAF. The pilot of a Dutch-registered glider replied to the Beech pilot's broadcast, advising that his glider was 12 NM east of the airport at 3,300 ft and tracking northward. At the time, there were a number of fire-bombing aircraft operating nearby and a group of over 30 gliders involved in a competition transiting the area. The Beech pilot broadcast again on the CTAF when 13 NM east of Griffith, descending through 4,500 ft, the aircraft's TCAS indicated traffic 800 ft below. The pilot visually identified the Dutch glider beneath him, which was climbing, and broadcast on the CTAF that he was in the 2 o'clock high position relative to the glider. Initiating avoiding action, the Beech pilot discontinued his approach and commenced a right turn and shallow climb. The aircraft passed about 275 m horizontally and about 60 ft vertically. As a result of this occurrence, the Gliding Federation of Australia (GFA) advised the ATSB that in future, it would email the aeromedical operator before gliding events where there is expected to be increased levels of glider activity (ATSB investigation AO-2013-009).
- During cruise near Port Pirie, SA while conducting a trauma recovery flight, the crew of the Eurocopter MBB-BK 117 helicopter received abnormal hydraulic indications. Uncommanded, the helicopter then pitched violently upwards and rolled left before descending. The crew regained control at about 800 ft AGL. Control checks confirmed normal control had resumed, and the crew returned to Port Pirie. No-one was injured, although the helicopter sustained minor damage. The ATSB did not find any mechanical or system faults that could account for the hydraulic system pressure fluctuations. The ATSB did find, however, that the helicopter was being operated at a weight, density altitude and airspeed, and in meteorological conditions that were conducive to the onset of retreating blade stall. The uncommanded and violent nose-up pitch and left roll were consistent with the onset of that condition. The pilot's instinctive action of pushing the cyclic control forward delayed recovery from the stall. As a result of this serious incident, the helicopter's operator issued an urgent Immediate Safety Notification advising all company BK 117 pilots of the conditions conducive to retreating blade stall and the correct actions to recover from that condition r (ATSB investigation AO-2013-030).
- A Beech King Air was about 15 NM from Wangaratta, Vic. and on descent when the pilot observed a glider approaching at the same level. The glider passed the left side of the aircraft

with separation reducing to about 70 m at the same altitude. The pilot of the Beech did not have an opportunity to take evasive action, nor did he observe the glider take evasive action. He also did not hear any broadcasts from the glider pilot on the area very high frequency (VHF), or receive a TCAS TA. Attempts to contact the glider pilot were unsuccessful (ATSB investigation AO-2013-032).

- A Beech King Air was on approach to land at Port Keats, NT after conducting an aeromedical flight from Darwin. In preparation for landing, the pilot selected the gear down. However, while the nose landing gear down indication light (green) illuminated, the left and right main landing gear down indication lights did not illuminate.. The pilot elected to return to Darwin and advised air traffic control. On landing at Darwin, the pilot reported that the right main landing gear wheel touched down first. When the left landing gear wheel touched down, the pilot felt the left side of the aircraft start to sink. The pilot shut down the left engine and feathered the left propeller, then shut down the right engine and feathered the right propeller. The left wing then contacted the runway and the aircraft skidded to a stop. The pilot and flight nurses evacuated the aircraft via the over-wing exit without injuries (ATSB investigation AO-2013-062).

Left main landing gear collapse involving a Beech B200 King Air (VH-ZCO), at Darwin Airport, Northern Territory (ATSB investigation AO-2013-062)

- A loss of separation occurred between a Bell 412 helicopter conducting EMS operations and a Jetstar Airbus A320 near Avalon Airport, Vic. This serious incident was discussed above in *High capacity RPT* on page 19 (ATSB investigation AO-2013-115).
- An Agusta AW139 helicopter was on approach to Archerfield Airport, Qld at the same time as a Cessna 172 was conducting night circuit training, as well as two other aircraft conducting night circuits. The helicopter pilot made an inbound call, advising that they were 5 NM to the north of the airport at 1,400 ft above mean sea level (AMSL). The Agusta pilot reported sighting two other aircraft in the circuit, and noted that they were unlikely to come into conflict with the helicopter. The student pilot of the Cessna then made a broadcast to advise he was turning base for a touch and go landing on runway 10, and that they were conducting a simulated landing light failure. About 15 seconds later while the Cessna was on final, the

Agusta pilot broadcast a call advising he was on a tight left base for runway 10. The instructor in the Cessna sighted the Agusta on a close base in his 10 o'clock position about 1 NM away, and broadcast a call asking the Agusta pilot whether he had the Cessna sighted. He did not hear a response, so conducted a go-around to ensure separation with the Agusta. At about the same time, the Agusta pilot was at 300 ft AGL and saw the Cessna in his 4 o'clock position about 100 ft below and behind conducting the go-around. The Agusta pilot tightened the turn onto final and landed on the parallel taxiway. He reported that he had not received a TCAS alert on the Cessna, although the Cessna pilot reported that their transponder was on and operational. An ATSB review of the appropriate recordings showed that all of the Cessna and Agusta pilots' transmissions were broadcast on the CTAF (ATSB investigation AO-2013-134).

- The crew of a Bell 412 helicopter was tasked to pick up a patient who was reported to have fallen in a heavily-wooded area in steep terrain about 1 to 1.5 km from the nearest road near Lake Eildon, Vic. The crew consisted of a pilot, aircrewman and a flight paramedic. The crew decided that a stretcher winch would be too dangerous so elected for a double-lift extraction with the patient in a rescue/retrieval strop. The helicopter was positioned at 80 ft AGL (about 20 ft above the tree canopy) for the winch.

Operational accident involving a Bell 412 helicopter (VH-VAS), near Mansfield, Victoria (ATSB investigation AO-2013-136) – example of a double-lift with a rescue/retrieval strop

Initially the winching procedure appeared to proceed normally, despite the paramedic coming into contact with some branches on the way up. The helicopter was moved slightly and the winch continued. The aircrewman reported that once the paramedic and patient were clear of the canopy, at about 15 ft below the aircraft, he noticed that the patient was moving or wriggling. The aircrewman stopped the winch for a control check, and shortly after resuming the winch noticed that the patient's arms were not in the usual position in the strop and that the paramedic appeared to be shouting at the patient. The aircrewman elected to continue winching in, and informed the pilot that the patient was slipping. The paramedic reported attempting to pin the patient against the skid in an attempt to stop him slipping. The aircrewman continued winching until the paramedic's head was level with the middle of the door opening. At this stage the aircrewman informed the pilot that he could see the patient slipping further. He dropped the winch pendant and reached down, grabbing the patient's shoulder in an attempt to stop his fall. The aircrewman stated that by

this stage the patient appeared to be unresponsive and limp. Despite the crew's efforts, the patient slipped out of the strop and fell to the ground, sustaining fatal injuries. The ATSB investigation into this accident is underway, looking into a number areas including the design and suitability of the strop for the weight and physical dimensions of the patient, and potential medical issues associated with patients being winched in strops. The ATSB is also reviewing the operator's rescue procedures, and the certification procedures for helicopter winching rescue equipment (ATSB investigation AO-2013-136).

The remaining two serious incidents not investigated by the ATSB involved a separation issue between an EMS helicopter and a high capacity RPT flight (see *High capacity RPT* on page 18), and an ambulance driving through a temporary landing site when an EMS helicopter was on final approach.

Search and rescue

The ATSB is notified of very few accidents and incidents involving aircraft conducting search and rescue operations. In the last 10 years, there were no aircraft in this category involved in accidents and only seven in serious incidents (Table 14).

The low number of occurrences reported to the ATSB is likely due to the very small amount of search and rescue flying in Australia (relative to other types of general aviation) – about one per cent of all aerial work in Australia in 2013.

Table 14: Occurrences involving general aviation aircraft conducting search and rescue operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	4	7	7	6	2	4	4	6	7	7
Serious incidents	0	0	0	0	1	0	3	0	3	0
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	0	0	0	0	0	0	0	0	0	0
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	0	0	0	0	0	0

In 2013, there were no search and rescue aircraft involved in accidents or serious incidents.

Fire control

There are generally few accidents or serious incidents reported to the ATSB in aerial firebombing operations, despite potential hazards associated with reduced visibility, spatial disorientation, low-level manoeuvring, and high operating weight. In 2013, however, there were two accidents and one serious incident, one of which was fatal (Table 15). Activity data (in terms of hours flown) is not available for this type of aerial work.

Table 15: Occurrences involving general aviation aircraft conducting fire control operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	3	1	6	3	1	7	1	0	3	3
Serious incidents	1	2	1	1	1	3	0	0	1	1
Serious injury accidents	0	0	0	0	0	1	0	0	0	0
Fatal accidents	0	0	1	0	0	1	0	0	0	1
Total accidents	1	0	3	1	0	4	0	0	0	2
Number of people involved										
Serious injuries	0	0	0	0	0	2	0	0	0	0
Fatalities	0	0	1	0	0	1	0	0	0	1

Aerial fire control accidents and serious incidents in 2013 are described below:

- A Eurocopter AS.350 was conducting water bombing of a fire near Hobart when it collided with terrain. The pilot, who was the sole person on board, suffered minor injuries while the helicopter was substantially damaged. The spot fire that the helicopter was working on was not particularly large, but was on a downhill slope and in a gully. The pilot reported that the overall wind was north-north-westerly, but the fire created a localised westerly in-draft within the gully. The pilot slowed the helicopter in preparation for the water drop. Approaching the hover at about 80 ft AGL, and immediately following the loss of translational lift, the helicopter suddenly commenced an uncommanded left yaw and descent. Without any warnings or alarms, the helicopter rotated rapidly two to three times to the left. The pilot raised the collective to decrease the rate of descent, and countered the yaw with anti-torque pedal input; however, the rate of yaw increased. The pilot reported that 'in a very short period of time', the helicopter was in the trees. Although the reason for the accident could not be conclusively established, the described behaviour of the helicopter by the pilot was consistent with a loss of tail rotor effectiveness (ATSB investigation AO-2013-026).

Collision with terrain involving a Eurocopter AS.350 B2 helicopter (VH-EWM), near Hobart, Tasmania (ATSB investigation AO-2013-026)

- A PZL Mielec M18A Dromader took off from Nowra, NSW to conduct water bombing of a fire in the Budawang National Park. While the aircraft was approaching the target point, the left wing separated. The aircraft immediately rolled left and descended, impacting terrain. The aircraft was destroyed in the impact and the pilot fatally injured. Preliminary examination of the aircraft by the ATSB indicated that the left outboard wing lower attachment lug had fractured through an area of pre-existing fatigue cracking in the lug lower ligament. The ATSB has identified a safety issue with some Australian-registered M18 Dromaders, especially those fitted with turbine engines and enlarged hoppers or under a supplemental type certificate to allow operations at takeoff weights up to 6,600 kg (which included the accident aircraft). In some of these aircraft, flights have probably been conducted at weights for which airframe life factoring was required but not applied. The ATSB has previously conducted investigations into M18 Dromader accidents where an in-flight break-up or serious control issue has occurred, and published a safety issue investigation into operations of the M18 Dromader at take-off weights above 4,200 kg. The ATSB investigation of this accident is continuing and will include examination of the wing attachment point inspection procedures and methods used in practice, approval mechanisms for the alternate method of compliance, and the history of the aircraft's operations and maintenance (ATSB investigation AO-2013-187).
- During aerial fire-fighting operations near Wyong, NSW, the underslung water bucket suspended from the Garlick UH-1H helicopter struck a powerline. The crew jettisoned the bucket. The helicopter was not damaged and there were no injuries to the crew. The ATSB did not believe that there was a potential for systemic safety enhancement by investigating this serious incident (ATSB occurrence 201310445).

Survey and photography

Very few occurrences are reported to the ATSB involving aircraft conducting survey and photography aerial work, although the number of accidents reported in 2013 was the highest in 5 years (Table 16).

Table 16: Occurrences involving general aviation aircraft conducting survey and photography operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	8	10	11	15	17	24	29	27	17	26
Serious incidents	0	0	1	1	1	2	3	3	7	4
Serious injury accidents	0	1	1	0	1	0	1	0	0	0
Fatal accidents	0	0	2	1	2	0	0	2	0	0
Total accidents	0	2	3	2	7	3	5	4	0	6
Number of people involved										
Serious injuries	0	1	1	0	3	0	2	1	0	0
Fatalities	0	0	7	1	2	0	0	4	0	0
Rate of aircraft involved										
Accidents per million hours	0	61.2	67	36.9	108.6	78.2	85.5	58.7	0	N/A
Fatal accidents per million hours	0	0	44.7	18.4	31	0	0	29.4	0	N/A

Five of the 10 accidents and serious incidents involving survey and photography aircraft in 2013 were investigated by the ATSB, and are described below:

- A Bell 206B helicopter was conducting aerial filming of a truck accident over hilly terrain in the north-eastern outskirts of Perth. The weather was fine with east to north-easterly winds of 10 to 15 kts. After hovering and manoeuvring at about 500 ft AGL to allow the camera operator to take footage, the pilot conducted a right orbit to complete filming and depart the area. The pilot had initiated the turn when the nose of the aircraft moved left and then suddenly rapidly to the right. The helicopter yawed and rotated about five times before the pilot could retain some control close to the ground. The pilot selected a clearing and managed the available energy to perform a low impact landing, although due to the slope the helicopter immediately rolled over with the engine still operating. There was no fire, and the pilot and camera operator escaped with minor injuries. The ATSB investigation into this accident found that when the pilot turned to the right to commence the orbit, the helicopter was exposed to a crosswind from the left while at an airspeed around the 30 kt threshold value for susceptibility to loss of tail rotor effectiveness (LTE). This precipitated an unanticipated right yaw and temporary loss of control. The pilot regained sufficient control for a forced landing, but he did not use full left pedal as recommended for loss of tail rotor effectiveness, resulting in a likely delay in recovery (ATSB investigation AO-2013-016).

Loss of control and forced landing involving a Bell 206B helicopter (VH-ZMN), near Perth, Western Australia (ATSB investigation AO-2013-016)

- A Piper PA-31 Navajo was conducting an IFR flight from Flinders Island, Tas. to Moorabbin Airport in Melbourne. During the descent into Moorabbin, the aircraft entered visual conditions, and the crew then advised ATC that they intended to track visually to Moorabbin via the visual flight rules (VFR) reporting point at Carrum. At about the same time, a Cessna 172 travelling from the West Gate Bridge area was transiting via the VFR Costal Route to Tyabb. The Cessna pilot received ATC clearance to transit the western edge of the Moorabbin control zone, about 1.5 NM off the coast to remain within gliding distance to the land. The Piper pilot called ATC at Carrum at about 1,500 ft, and on a descent profile to arrive at the Moorabbin control zone entry at the required altitude of 1,000 ft. Less than a minute later, both aircraft saw each other on a reciprocal track. The Cessna commenced a climb to the right, and the Piper commenced a descent to the right, resulting in the Cessna passing over the Piper by about 200 ft. As a result of this serious incident, the operator of the Cessna advised the ATSB that they are looking for a safer route to track from the West Gate Bridge to Tyabb, and are consulting Moorabbin Tower to determine the correct altitude for this leg (ATSB investigation AO-2013-073).
- The pilot of a Bell 47G helicopter took off from Lake Manchester, Qld on a local aerial photography flight. The pilot had taken off with carburettor heat on, as it was required for the climb and then adjusted the amount of carburettor heat required as indicated by the carburettor gauge. He referred to the gauge about every 30 seconds during the flight. During the third photography shoot, the pilot was climbing through about 1,300 ft AMSL when the engine stopped suddenly. The pilot established the helicopter in an autorotation, and within 40 seconds of the engine failure the helicopter landed heavily. Although the helicopter was substantially damaged, neither the pilot nor the photographer was injured. The ATSB investigation found that almost no carburettor heat was on at the time of the engine failure, with the lever at about one-eighth of the available travel. According to the Carburettor Icing

Probability chart, the conditions indicated a serious probability of carburettor icing at any power (ATSB investigation AO-2013-119).

- A Bell 206B helicopter departed Horn Island, Qld for an aerial filming flight at low level about 5 NM away at the Tuesday Islets. The purpose of the flight was to film a vessel travelling back and forth along a channel in between the islets. After having completed four passes over the vessel, the pilot positioned the helicopter for the next pass. Maintaining 200 ft, the helicopter approached the vessel from behind and to the left. The vessel was travelling into wind. As the helicopter flew abeam the vessel, the pilot initiated a climb and then commenced a right turn to pass in front. At that time, the pilot was monitoring the view finder to ensure that the helicopter's skids did not impede the film shot. After having completed the film shot and at about 450 ft, the helicopter entered an uncommanded yaw right by about 25 to 30° and started to experience a loss of tail rotor effectiveness (LTE). The helicopter rotation stopped momentarily, but shortly after began to yaw right again. Despite the pilot's attempt to recover the situation, the helicopter continued to yaw right and descend. When below 100 ft, the pilot determined that he was unable to recover and he prepared to ditch onto the water. The emergency flotation system was activated and the helicopter landed on the water. The occupants were not injured. As a result of this accident, the helicopter operator now requires all of its pilots to demonstrate their ability to recover from an LTE event during regular flight checks with the Chief Pilot (ATSB investigation AO-2013-121).
- A Robinson R44 helicopter was being used to conduct gravity survey work near Daly Waters, NT. On board were the pilot and a geophysical field technician. The survey consisted on landing about every 4 km along a planned grid to collect data. After a routine landing at a designated grid point, the technician left the helicopter with his equipment to carry out a reading about 5 m from the helicopter. A short time later, the pilot noticed that the technician was waving his arms to get his attention. The pilot looked towards the rear of the helicopter and saw a fire underneath, which was spreading into the engine bay. The pilot exited the helicopter and notified the landholders via phone so they could construct fire breaks to contain the ensuing grass fire. The occupants were uninjured, however, the helicopter was destroyed by the fire. The ATSB has been notified of 13 occurrences since 2000 where a helicopter has been destroyed by grass fire, with many reports highlighting the speed with which the grass ignited and the fire spread beyond control (ATSB investigation AO-2013-192).

Ground fire involving a Robinson R44 helicopter (VH-TZE), near Daly Waters, Northern Territory (ATSB investigation AO-2013-192)

The remaining five occurrences not investigated involved a RPA that crashed after the data link was lost, a wirestrike due to sun glare obscuring the wire, an engine failure, and a separation issue between two aircraft.

Flying training

In 2013 there were 16 accidents involving flying training, one of which resulted in a fatality. There were also 48 flying training aircraft involved in serious incidents, which was the highest number reported in the last 10 years (Table 17).

Table 17: Flying training (VH- registered) aircraft occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	283	327	295	266	210	226	214	210	224	296
Serious incidents	11	12	22	18	18	24	30	22	45	48
Serious injury accidents	1	0	1	0	0	1	2	0	1	0
Fatal accidents	1	1	0	0	3	1	0	1	1	1
Total accidents	14	23	12	19	22	22	16	13	15	16
Number of people involved										
Serious injuries	2	0	1	0	0	1	3	1	1	0
Fatalities	2	1	0	0	4	1	0	2	2	1
Rate of aircraft involved										
Accidents per million hours	39.2	54.7	28	41.2	44.9	44	36.4	33.3	43.8	N/A
Fatal accidents per million hours	2.8	2.4	0	0	6.1	2	0	2.6	2.7	N/A

The single fatal accident involving flying training in 2013 is described below:

- The pilot of a Cessna 182 was conducting solo night circuits at Hamilton Airport, Vic. as part of a First Officer cadetship program. Witnesses observed the aircraft perform a go-around from runway 35 before turning to the right and descending into the ground. The pilot was fatally injured and an intense post-impact fire engulfed the aircraft. Dark night conditions, with no discernible horizon, were reported to have been present at the time of the accident. Other pilots who were also operating in the circuit area reported light to moderate turbulence and an increasing westerly crosswind. Examination of the wreckage by the ATSB identified that the flaps were in the fully-extended position of about 40° at ground impact. No pre-existing damage or defects were identified with the aircraft during this examination. The ATSB investigation is currently underway and will examine recovered aircraft components, the maintenance and operational documentation of the aircraft, the pilot's training records, and the effect of weather conditions (ATSB investigation AO-2013-163).

The non-fatal flying training accidents and serious incidents in 2013 involved a number of common themes, which were also seen in other types of GA operations:

- in helicopter training, a loss of control (due to inappropriate or untimely control inputs or power setting changes) leading to a hard landing, incorrectly executed autorotation, or tail rotor strike
- landing gear mechanical failures, sometimes associated with a wheels-up landing or loss of control during landing
- aircraft coming too close to each other when approaching the same VFR reporting points, or when an operational change occurred
- engine failures in single-engine aircraft associated with a successful forced landing or air return

- aircraft operating in non-controlled airspace that came too close to each other due to one or both aircraft not broadcasting on or monitoring the CTAF (or using the wrong frequency), leading to a reliance on unalerted see-and-avoid
- aircraft coming too close to each other in a circuit or sequence due to pilots misidentifying other aircraft, or turning too soon
- hard landings resulting in a ground strike.

Some notable occurrences that were investigated by the ATSB in 2013 are described below:

- Two Cessna 172 aircraft were among six aircraft conducting night circuits at Moorabbin Airport, Vic. Both Cessna aircraft were engaged in flying training, one a dual flight and the other solo. The pilot of the solo Cessna was instructed by ATC to follow the preceding aircraft, which was the dual Cessna. As the solo Cessna approach the position where the pilot normally turned downwind onto base, the pilot looked to the left and identified what he thought were the flashing lights of the aircraft he had been instructed to follow. As the pilot of the solo Cessna levelled out on final, ATC queried whether he still had the aircraft he had been instructed to follow in sight. Before he could answer, the instructor pilot of the dual Cessna transmitted that he was descending. After acknowledging the dual Cessna, ATC instructed the pilot of the solo Cessna to go-around. As a result of this near-miss, the operator of the solo Cessna advised the ATSB that they have implemented a night-flying checklist to record details briefed to students on expected flight conditions and traffic densities. Also as a result of this occurrence, the operator of the dual Cessna has implemented a procedure to liaise with other training organisations at Moorabbin to determine the number of aircraft programmed for night circuits (ATSB investigation AO-2013-053).
- The student pilot of a Cessna 172 conducted a solo navigation flight from Archerfield Airport to Sunshine Coast Airport via Caboolture, Qld. After landing at Sunshine Coast Airport, the student pilot taxied the aircraft to the general aviation apron. Other aircraft were operating around the apron, and the pilot wanted to ensure he remained clear of them. The pilot noted a fence and power pole on his left, and then focused on an aircraft taxiing in front of his Cessna. While the pilot was watching the other aircraft taxiing, the Cessna may have rolled forward unnoticed. When the pilot commenced a right turn, the aircraft was past the end of the fence and as he turned the aircraft, the left wing collided with a power pole (ATSB investigation AO-2013-128).
- A Piper PA-44 was en route to Rottnest Island from Perth to conduct IFR navaid training. On board were a flight instructor and a student. There were other IFR training aircraft on the Rottnest Island CTAF when the Piper arrived over the navaid to commence practice non-directional beacon (NDB) training. Both the instructor and student made frequent broadcasts on the CTAF to advise other traffic of the aircraft's position and their intentions. The weather was IMC, and conditions were deteriorating as a large cold front was moving rapidly in from the south-west. As the Piper was inbound in the holding pattern at 2,000 ft, ATC advised the crew than an IFR Mooney M20 was inbound to Rottnest Island for instrument navaid training, and would be descending from 3,000 ft. The controller provided an estimated time of arrival of the Mooney overhead the NDB, to which the Piper's flight instructor acknowledged. Shortly after, the Mooney encountered severe turbulence at their current level and requested a descent to 2,000 ft. This descent took the aircraft from controlled airspace into uncontrolled airspace, and therefore the pilot was now responsible for maintaining separation with other aircraft. When the flight crew of the Piper had not heard from the Mooney on the CTAF, the instructor tried unsuccessfully to raise them on the CTAF. He then contacted ATC on the Perth Centre frequency, who provided traffic information and allowed the pilots to arrange mutual separation (ATSB investigation AO-2013-176).
- The student pilot of a Grob G-115 departed Merredin on his first solo flight to a training area located near Lake Brown, WA. About one and a half hours into the flight, the student elected to return to Merredin, tracking via Burracoppin. The student pilot was unable to identify Merredin airstrip, and made a broadcast on the universal communications (UNICOM) frequency that he

was unsure of his position. The UNICOM operator gave him directions shortly before about 1700 local time. On short final, he determined that he was too high and initiated a go-around. On the second circuit, the student reported that there was a crosswind with slight windshear, and sun glare was making it increasingly difficult to see the runway. The aircraft touched down heavily and bounced. The student reported that the sun glare made it very difficult to judge the height of the aircraft. He touched down again on the nose landing gear, which collapsed, and the Grob slid along the runway to a stop. The pilot was uninjured but the aircraft was substantially damaged. (ATSB investigation AO-2013-178).

Hard landing involving a Grob G-115 (VH-ZIV), at Merredin, Western Australia (ATSB investigation AO-2013-178)

- A flight instructor and a student pilot taxied a Schiweizer 269C helicopter to the southern helipad at Moorabbin Airport to conduct circuits. Runway 17L was the designated runway in use at the time. The helicopter circuit area was the 'Eastern Grass', which was 20 m east of and parallel to runway 17L. The pilot of a Piper PA-31 requested ATC clearance for an IFR flight to Tasmania, and commenced taxiing for runway 17L. A few minutes later, the pilot of an aircraft taxiing for circuits reported ready at the holding point of runway 17L. To facilitate re-sequencing of the aircraft, the controller opted to change the departure runway for the Piper from runway 17L to runway 13L. At this time, the helicopter was on the threshold of runway 31R at the far end of runway 13L. The controller did not see the helicopter when conducting a scan of the runway prior to clearing the Piper for take-off from runway 13L. When about two-thirds of the way along the runway, the pilot of the Piper sighted the helicopter ahead. As the Piper had already exceeded its minimum rotate speed, the pilot continued the take-off, increased the aircraft's angle of climb, and passed about 100 to 200 ft above the helicopter (ATSB investigation AO-2013-189).
- The flight instructor and student pilot of a Cessna 152 were conducting circuits at Tyabb, Vic. A Jabiru J160 with a pilot and passenger on board was taxiing for a local flight, making a call on the CTAF and taxiing towards the runway 17 holding point. They stopped the aircraft short of the holding point and turned at an angle to maximise his view of the base and final legs of the circuit. When on a close downwind leg in-line with the runway 17 threshold, the pilot of the

Cessna broadcast he was turning base for a glide approach, and commenced a continuous turn towards runway 17. The pilot of the Jabiru heard the broadcast and looked for the Cessna but was unable to sight it. He then broadcast that he was lining up and rolling on runway 17, and commenced the take-off run. The Cessna was on a high close final, and the pilot reported broadcasting turning final. Neither pilot heard the other pilot's broadcast. The student pilot of the Cessna continued the glide approach, aiming to touch down about half way along the runway. As the Jabiru became airborne, at about 15 ft AGL, the pilot saw the underside of the Cessna appear from above. It was overtaking the Jabiru very slowly and descending. The Cessna descended onto the Jabiru and the elevator trim tab impacted the fin of the Jabiru. The Jabiru landed and skidded along the runway. The Cessna pilot heard a loud bang but did not see the Jabiru and commenced a go-around. The aircraft required full back pressure on the control column and full back trim to climb, so he conducted a low level circuit and returned for landing. The Jabiru was substantially damaged and the Cessna sustained damage to the right elevator and trim tab (ATSB investigation AO-2013-205).

- A flight instructor and a student pilot were conducting flying training in a Beech A36 Bonanza at Camden, NSW. The purpose of the flight was to enable the student to obtain a retractable undercarriage (landing gear) endorsement. After completing about 45 minutes upper air training in the local training area, they obtained a clearance from ATC for a straight-in approach to runway 06 at Camden. During the approach, the student completed the pre-landing checks, which included extending the landing gear and selecting flap. The aircraft touched down about 50 to 100 m past the runway threshold and about 2 m left of the centreline. The instructor advised the student to re-align the aircraft with the runway centreline, focusing his attention outside the cockpit watching the re-alignment. The student became concerned about the length of runway remaining and quickly moved to retract the flaps and prepare the aircraft for take-off. The student had completed all his recent training in a Cessna 182 which has the flap control to the right of the power quadrant. This led to him inadvertently manipulating the landing gear lever in the Beech. The instructor attempted to recover the aircraft, but it veered right and the nose dug into the grass verge alongside the runway. As a result of this accident, the aircraft operator advised the ATSB that the company has changed their procedure for retractable design type endorsements. From now, instructors undertaking this type of endorsement training with students are required to conduct a full stop landing on the first approach (ATSB investigation AO-2013-207).

Incorrect configuration event involving a Beech A36 Bonanza (VH-YEN), at Camden Airport, New South Wales (ATSB investigation AO-2013-207)

Private/business/sports aviation

Private/business and sports aviation generally describes aircraft that are being operated for pleasure or recreation, or are being used for a business or professional need, including private aerial stock mustering and survey flights. It is often difficult to distinguish between business and private operations, so they are aggregated for the purposes of this report.

It is important to note that only aircraft conducting these operations that are registered on the Australian civil aircraft (VH-) register are included in this section. Sports and recreational aircraft that are registered under RAAO schemes are considered separately in the *Recreational* section of this report on page 73.

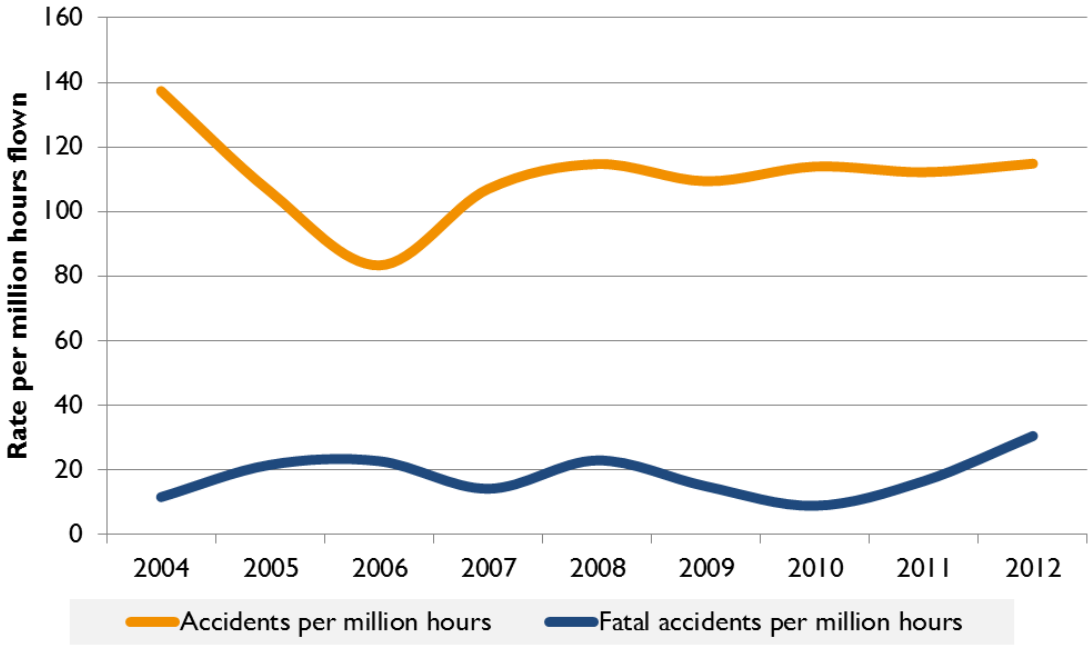
In 2013, there were 231 private/business/sports aviation aircraft that were involved in an occurrence reported to the ATSB, representing a fall since 2012. There were also fewer fatal (11) and serious injury (three) accidents in 2013 (Table 18).

Table 18: Private/business/sports aviation (VH-registered) aircraft occurrences (including gliding), 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	201	193	205	213	187	203	161	191	168	136
Serious incidents	22	13	15	24	17	21	21	38	43	44
Serious injury accidents	7	2	5	5	9	6	8	7	3	3
Fatal accidents	7	13	15	9	13	9	5	9	17	11
Total accidents	83	64	55	68	65	66	64	61	64	51
Number of people involved										
Serious injuries	10	3	10	7	14	7	10	12	6	3
Fatalities	16	18	25	18	23	9	7	17	25	20
Rate of aircraft involved										
Accidents per million hours	137.3	106.2	83.4	107.0	114.7	109.4	113.9	112.2	114.8	N/A
Fatal accidents per million hours	11.6	21.6	22.7	14.2	22.9	14.9	8.9	16.6	30.5	N/A

In 2012, private/business and sport (including gliding) operations had the highest annual accident rates of any GA operation type. In 2012, there were about 115 accidents per million hours flown (only marginally larger than aerial agriculture), and about 31 fatal accidents per million hours flown (Table 18).The fatal accident rate in private/business operations has increased over the last few years, tripling between 2010 and 2012.

Figure 17: Accident rate for aircraft (VH- registered) involved in private, business, sport and gliding operations (per million hours flown), 2004 to 2012[16]



[16] Hours flown for gliding operations is not available for 2004, so 2004 was estimated using 2005 hours flown data for gliding hours only.

Private/business

There were over 2,300 aircraft being used for private or business flying in the last 10 years that were involved in incidents, serious incidents, and accidents that were reported to the ATSB (Table 19). Incidents reported to the ATSB increased between 2004 and 2007, but have generally decreased since then. The number of incidents reported in 2013 was the lowest in 10 years, as was the number of accidents.

Table 19: Occurrences involving general aviation aircraft conducting private and business operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	164	167	193	196	162	185	136	165	146	117
Serious incidents	19	12	14	19	14	17	14	27	34	28
Serious injury accidents	3	0	4	4	7	3	5	4	1	2
Fatal accidents	6	9	12	7	11	6	5	8	14	10
Total accidents	72	53	48	58	58	57	57	43	50	42
Number of people involved										
Serious injuries	6	1	9	6	12	3	6	9	3	2
Fatalities	15	14	21	15	20	6	7	16	21	19

As the amount of flying activity has been relatively constant over the last decade at about 370,000 to 400,000 hours flown per annum, the decrease in reporting may represent less safety incidents occurring in recent years, or may suggest a level of underreporting of occurrences to the ATSB. The ATSB conservatively estimates that 25 to 30 per cent of all aviation safety incidents in Australia each year are not reported. A major challenge for the ATSB in its charter to improve transport safety is that there is a lower level of awareness in the GA community of the need to report safety incidents, and what constitutes a reportable transport safety matter. Future amendments to the Transport Safety Investigation Regulations will clarify what industry needs to report, in order to make reporting clearer and less onerous for pilots and operators alike. It is hoped that these changes, along with improved engagement with the GA community by the ATSB (through programs such as *SafetyWatch* and the popular *Avoidable Accidents* series) will help to reduce underreporting of incidents.

The number of hours flown in sports aviation is not collected separately from private/business hours, so rate data is not available for private/business or sports aviation operation types individually.

There were 42 accidents in private and business operations in 2013 involving VH- registered aircraft, and 28 serious incidents. Ten of these accidents were fatal, and two resulted in serious injuries. These accidents are described below:

- A Robinson R22 helicopter with a pilot and passenger on board went on a return flight from a station homestead near Manton Dam, NT. On return to the homestead and on approach to land, the pilot turned the helicopter in a northerly direction to terminate in a hover. The pilot reported that he had difficulty maintaining control of the helicopter in the hover and decided to conduct a go-around. As the pilot had previously turned the helicopter to face the north, his departure path was not the usual one he used and required a steeper profile to clear trees located near the landing area. During the go-around at about 40 ft AGL and at an airspeed of between 25 to 30 kt, the helicopter suddenly yawed to the right and completed 3 to 4 revolutions before impacting trees. The helicopter came to rest inverted and was seriously damaged. The pilot was able to exit with minor injuries and assisted the passenger, who was seriously injured, to exit the helicopter. The ATSB investigation into this accident found that the

pilot had returned early to the homestead to avoid windy and rainy conditions. The pilot reported that if he was unsure of the wind, he would overfly the airstrip and confirm the direction of the wind via the windsock, as the windsock was not visible on approach to the homestead. The pilot commented that during the wet season the wind was always from the north-west and he did not overfly the airstrip windsock on the day of the accident. On the day of the accident, light winds (3 to 7 kt) at 280° were recorded at a nearby monitoring station. Wind will cause anti-torque system thrust variations to occur in helicopters. Certain relative wind directions are more likely to cause tail rotor thrust variations than others. Knowing which direction the wind is coming from is critical – especially in light wind conditions. Any manoeuvre which requires the pilot to operate in a high-power, low-airspeed environment with a left crosswind or tailwind creates an environment where unanticipated right yaw may occur. During the go around, the pilot may have inadvertently placed the wind relative to the helicopter in the critical azimuth area, between 288° and 315°, where main rotor vortices may interact with the tail rotor, increasing the likelihood of LTE (ATSB investigation AO-2013-021).

Loss of control involving a Robinson R22 helicopter (VH-HGI), at Adelaide River Station, Northern Territory (ATSB investigation AO-2013-021)

- The pilot of an amateur-built scale Supermarine Spitfire Mk. 26 was participating in an airshow at Parafield Airport, SA. The pilot performed a number of airborne passes above the runways in various directions, and completed the display with a slow speed pass at 400 ft with the landing gear and some wing flap extended. Towards the end of this pass, the pilot radioed Parafield Tower to coordinate a landing and accepted runway 21L with an 11 kt crosswind. By this time, the pilot had turned right and the Spitfire was near the extended runway centreline about 1 km from the runway threshold, and travelling at a slow speed. Witnesses observed the Spitfire make a left turn, and soon after, a wing dropped and the aircraft entered a steep descent. The aircraft crashed in a factory car park near the airport boundary, fatally injuring the pilot and substantially damaging the aircraft. The ATSB investigation into this accident found

that while coordinating a landing clearance with ATC and flying a low level circuit with a close downwind and base in turbulent conditions, the pilot inadvertently allowed the Spitfire's airspeed to decay. In the subsequent downwind turn to adjust the circuit, the aircraft aerodynamically stalled, descended steeply, and impacted the ground. The ATSB found that this particular type of aircraft was prone to aerodynamically stall with little or no aerodynamic precursor, and the risk of an inadvertent stall was increased because it was not fitted with a stall warning device (ATSB investigation AO-2013-051).

Loss of control involving a Supermarine Spitfire scale-replica (VH-VSF), near Parafield Airport, South Australia (ATSB investigation AO-2013-051)

- A Robinson R44 helicopter was manoeuvring at a grassed area adjacent to a function centre at Bulli Tops, NSW. Shortly after landing, the helicopter lifted off and turned to the right. The main rotor struck branches of a nearby tree, and the helicopter descended and then rolled over onto its right side. A fire started on the grass under the rotor mast and the cabin. The pilot and the three passengers were fatally injured. The ATSB found that the circumstances of this accident were consistent with two recent R44 accidents in Australia involving low-energy impacts that resulted in the all-aluminium fuel tanks being breached and a fuel-fed fire. R44 accidents result in a significantly higher proportion of post-impact fires than for other similar helicopter types. The accident helicopter was also equipped with an all-aluminium tank. While the ATSB is yet to complete its investigation into this accident, R44 operators should note that fitment of bladder-type fuel tanks to R44 helicopters is a very important safety enhancement that could save lives. Replacement of rigid-type all-aluminium fuel tanks in R44 helicopters with bladder-type tanks has since been mandated by a manufacturer service bulletin, with all Australian-registered R44 helicopters required to be compliant by 30 April 2013. Owners of helicopters who may not be required to comply with this service bulletin are very strongly encouraged by the ATSB to fit bladder-type fuel tanks to reduce post-crash fire risks, and regulators and investigation agencies in other countries should consider what steps they can take to increase compliance with the manufacturer's safety bulletin (ATSB investigation AO-2013-055).

- A Cessna 210 took off from Roma, Qld with a pilot and a passenger on board on a night flight to Cloncurry. Shortly after take-off, the aircraft impacted terrain, fatally injuring both occupants. The ATSB investigation found that although the take-off direction and accident location were consistent with the pilot initiating a left turn shortly after take-off, the turn continued through the departure track until the aircraft descended and impacted terrain. Consideration of the take off direction identified that there was minimal ground lighting available to assist the pilot to control the aircraft by the use of external visual cues. The conduct of a take off in such dark night conditions, with no visible external horizon, would have necessitated the pilot controlling the aircraft solely by reference to the flight instruments once airborne. The pilot was not qualified to operate in night conditions and it was unlikely that he had the required level of instrument flight proficiency to safely operate the aircraft in dark night conditions. There was no evidence of any mechanical defect that would have affected the performance of the aircraft or suggested a need to return to the airport for landing. The likely flight path and impact sequence were consistent with the pilot probably experiencing spatial disorientation due to insufficient external visual cues. This likely disorientation led to a loss of control and collision with the terrain. (ATSB investigation AO-2013-057).
- The pilot of a Cessna 210 was one of a group intending to fly various light aircraft under VFR from Bullo River Homestead, NT to Emkaytee, a private airstrip near Darwin. Low cloud delayed all of the departures from Bullo River on the morning of the accident. Aviation forecasts and weather radar images accessed by the group via the internet indicated isolated thunderstorms, low cloud, and rain in the intended area of operation, with some improvement forecast from late morning. By lunchtime, the weather had lifted at Bullo River and the pilots observed that the weather radar images were indicating an improvement en route. All of the pilots departed in the early to mid-afternoon, some electing to track via the coast and the rest tracking directly. The pilot of the Cessna 210 departed with his wife and two daughters on board to track via the coast. The pilots in the group were communicating by radio on a discrete frequency, and the Cessna 210 pilot was heard to report that he was approaching Cape Ford with ‘gloomy’ weather ahead. That was the last radio transmission heard from the pilot. When the aircraft did not arrive at Emkaytee a search was initiated. Wreckage was found on the southern shoreline of Anson Bay, about 10 km south-east of Cape Ford. There were no survivors. The ATSB investigation into this accident determined that the pilot continued to track along the planned coastal route towards a thunderstorm, probably encountering conditions such as low cloud, reduced visibility and turbulence, and as a result of one or more of those factors the aircraft descended and collided with water (ATSB investigation AO-2013-063).
- During the approach to land at a private airstrip at Boxwood, Vic., the Cirrus SR22 collided with a tree. The pilot was attempting to land on the unlit strip after last light, and after colliding with the tree, lost control of the aircraft which became inverted and collided with terrain. The pilot, who was the sole occupant, was fatally injured and the aircraft was destroyed. The ATSB investigation into this accident found that the pilot was appropriately licensed to operate the aircraft at night and had passed a number of airports in the vicinity, all of which were appropriate for a night landing. However, consistent with a degree of self-imposed pressure to get home after a series of business commitments and prior to a 1-month period away from home, the pilot bypassed these airports and continued to their property airstrip. This airstrip did not meet the physical, lighting and obstacle clearance requirements for night operations. The final approach to land was made after last light, with a family member positioned in a motor vehicle at the end of the strip. The vehicle’s headlights were intended to illuminate the upwind end of the strip, facing the oncoming aircraft. However, this lighting was inadequate and provided insufficient guidance for the approach and landing (ATSB investigation AO-2013-104).
- The pilot-owner of a Cessna 206 landed on a public road to repair a truck at a remote work camp, 156 km south-southeast of Croydon, Qld. A few hours later, the pilot took off from a different, curved road with a passenger on board. At a height of about 30 ft AGL, the left wing of the Cessna struck a tree, and the wingtip and aileron separated from the aircraft. The aircraft

impacted terrain, fatally injuring both occupants and destroying the aircraft. The ATSB investigation into this accident found that the distance available from where the pilot increased power for take-off was much shorter than the distance advised in the aircraft's pilot operating handbook under the prevailing conditions. There was no apparent reason for the pilot to attempt a take-off from that location when a more suitable location was nearby. It is most likely that the pilot misjudged the distance available, the prevailing conditions and their effect on the aircraft's performance, or had a false recollection of the relative layout of the two roads and thought that there was more take-off room available beyond the curve. However, it is also possible that the pilot's judgement of the available distance, or his decision-making capability, was affected by a serious medical condition and/or prescribed medications that had not been reported to CASA until after the pilot's previous medical certificate had expired. In addition, the ATSB found that the pilot's seat had broken from its mounts, probably as the result of heavy, unsecured cargo striking it during the accident sequence. This could have had a detrimental effect on the survivability of the accident (ATSB investigation AO-2013-151).

Collision with terrain involving a Cessna 206 Stationair (VH-WAV), 156 km south-southeast of Croydon, Queensland (ATSB investigation AO-2013-151)

- An amateur-built Lancair Legacy was taking off from runway 32 at Geraldton Airport, WA. Late in the take-off roll the canopy opened. The pilot, who was the sole occupant of the Lancair, continued the take-off and manoeuvred at low level for a landing. During the approach the aircraft undershot the runway, touched down across a road then collided with the airport perimeter fence and caught fire. The aircraft was destroyed and the pilot sustained injuries that were later fatal. The ATSB found that the pilot conducted the take-off with the canopy down but inadvertently unlatched. As the aircraft accelerated the aerodynamic loads on the canopy increased and resulted in it suddenly lifting up to a partially open position. The pilot did not reject the take-off and during the subsequent manoeuvring for landing, likely encountered control, performance and forward visibility difficulties associated with the open canopy. This adversely affected the pilot's capacity to conduct a normal approach (ATSB investigation AO-2013-158).
- A Piper PA-28 departed from Lilydale, Vic. with the pilot and a passenger on board on a private flight to Charleville, Qld via Bourke, NSW. During the cruise, maintaining 8,500 ft AMSL, the

pilot selected an engine power setting of 65 per cent and leaned the fuel mixture. The pilot conducted fuel calculations every 30 minutes, and changed between the left and right fuel tanks to maintain the aircraft's balance within the normal operating limits. When approaching Bourke, the pilot calculated the fuel remaining on board based on the fuel gauge indications and the nominal fuel flow, and elected not to land at Bourke for refuelling, but to divert and continue directly to Charleville. Later in the flight, when about 20 NM east of Cunnamulla, Qld, the engine began to run rough and surge. The pilot assessed that the most likely cause was fuel contamination in the selected right tank, so he changed to the left fuel tank. The engine continued to run rough and the pilot elected to divert to Cunnamulla. The engine power then reduced to idle, and the pilot configured the aircraft for a forced landing. As it was dark by this time, the pilot turned on the landing light to illuminate a suitable landing site. The light flashed on and then failed. The aircraft landed in a paddock, bounced once, and during the subsequent landing roll collided with a tree. The aircraft was substantially damaged and the pilot and passenger were injured (ATSB investigation AO-2013-168).

- The pilot of an amateur-built Rand Robinson KR-2 took off from an airstrip on private property near Tumut, NSW on a weekend flight to nearby Holbrook. When the pilot did not return home on the Sunday evening, he was reported missing and a search commenced. The next morning, the wreckage of the KR-2 was found about 400 m northeast of the airstrip, and the pilot was fatally injured. Examination of the wreckage by the ATSB found that the aircraft had impacted the sloping ground in a left wing-low, nose-down attitude in a south-westerly direction. The impact resulted in the separation of the wings, rear fuselage and empennage from the main fuselage. The fuselage-mounted fuel tank ruptured and its contents destroyed a patch of grass up to 8m in front of the wreckage. There was no fire. One of the aircraft's two wooden propeller blades was broken off at the root and the other remained attached to the hub. Neither blade exhibited rotational scratch marks or evidence of power at impact. The upper spark plug on the rear-right cylinder was separated from the cylinder head but still connected to the plug lead and cylinder head temperature thermocouple lead. A portable GPS unit was found with the wreckage, which recorded the aircraft's track (but not altitude) on the accident flight. The recorded data showed that the pilot took off into the north-east before turning left onto a south-westerly heading. At a point adjacent to the downwind threshold of the 600 m airstrip, the aircraft turned left 90° and tracked south-east before turning left again to make what appeared to be a close-in left downwind leg. This was consistent with positioning to land into the south-west, the opposite direction to that used for the take-off. The recorded data finished after the aircraft passed to the east of the upwind threshold, indicating a sharp left turn at that time. The ATSB investigation is continuing to examine the aircraft's engine, propeller and instruments, maintenance records, and the pilot's medical and flying records (ATSB investigation AO-2013-174).
- The pilot of a Cessna 182 departed from Moruya, NSW on a morning flight to Mangalore, Vic. A witness at Mount Hotham Airport reported hearing and seeing a high wing aircraft flying near the airport mid-morning. The witness reported that the aircraft, the description of which was consistent with the accident aircraft, was heading in the direction of Melbourne. Another witness (who was camping about 4 km from the accident site) reported that at about the same time he heard an aircraft in the valley to the south-east of his location but 'could not see it due to the fog or cloud'. By early afternoon, the aircraft was two hours overdue at Mangalore and a search and rescue operation commenced. The aircraft wreckage was located the next morning at about 5,000 ft AMSL on the north-east side of Mt Blue Rag, Vic. The pilot was fatally injured and the aircraft destroyed. Examination of the wreckage by the ATSB found that the aircraft impacted rising terrain in a south-westerly direction with the wings level and a nose-down attitude of about 10°. The impact severely compressed the wings and fuselage. The fuel tanks, located within the wings, ruptured at impact but there was no fire. The engine, propeller and part of the forward fuselage were buried into the rising terrain from impact forces. Following the recovery of the engine and propeller from beneath the ground, an examination established that the engine was operating, and that the propeller was rotating with power being delivered by the

engine at impact. Examination of the aircraft's attitude indicator and airspeed indicator established that they were functioning at impact. The aircraft's altimeter indicator was 'captured' at an indication of 5,000 ft, which was consistent with the elevation of the accident site. Continuity and security of the airframe flight controls were established. The on-site inspection of the aircraft did not identify any defects that may have contributed to the accident. The local weather conditions at the time and location of the accident appeared to be poor. The witness at Mt Hotham Airport reported that when they saw the high wing aircraft 'clouds were around the tops of, and tumbling down the mountains, it was also raining or foggy at Hotham'. The witness at the campsite reported that the visibility at the camp site was less than 20 m at the time. The ATSB investigation is continuing to examine weather information pertaining to the flight, as well as aircraft maintenance documents, items recovered from the aircraft, and the pilot's medical and flying history (ATSB investigation AO-2013-186).

Collision with terrain involving a Cessna 182 Skylane (VH-KKM), near Mount Hotham, Victoria (ATSB investigation AO-2013-186)

- An amateur-built Lancair Legacy took off from Shepparton, Vic. with a pilot and passenger on board for a flight to Yarrawonga. Witnesses reported that the take-off and initial climb appeared normal, but shortly after the aircraft's pitch angle increased. This was followed by a descending right turn that continued until the aircraft collided with terrain alongside the airport boundary. The pilot and passenger were fatally injured. The weather forecast for Shepparton Airport at the time of the accident was for westerly winds up to 12 kt, with scattered cloud at 4,500 ft and visibility greater than 10 km. The impact with terrain separated the aircraft's left wing, empennage and engine from the main fuselage. Both wing fuel tanks ruptured and an intense post-impact fire ensued, destroying much of the aircraft's composite structure and liberating a large amount of fragmented carbon fibre material. When present as free fragments and particles, carbon fibre presents a respiratory hazard. This required a large area around the accident site to be cordoned off and investigators to use suitable protective equipment while examining the wreckage. The ATSB did not identify any pre-existing faults with the aircraft wreckage during the on-site phase of the investigation, although the examination was limited by the degree of damage sustained. The Lancair involved in the accident was assembled in South Africa by the previous owner, and prior to being imported to Australia, had been involved in an engine failure and forced landing in 2010. That accident caused substantial damage to the underside of the airframe that was repaired before the aircraft was sold. The ATSB

investigation is currently examining the history of the repair work after the 2010 accident, the assembly and maintenance of the aircraft after its importation to Australia, instruments and electronic equipment recovered from the aircraft, and the pilot's flying history and training (ATSB investigation AO-2013-193).

Collision with terrain involving a Lancair Legacy (VH-ICZ), at Shepparton Airport, Victoria (ATSB investigation AO-2013-193)

While the number of accidents was at a 10 year-low and the number of serious incidents decreased from a high in 2012, private and business operations again recorded the highest number of non-injury accidents in GA in 2013. Similar types of accidents and serious incidents involving GA aircraft happen time and time again, and most are avoidable. In 2013, these included:

- poor situational awareness when operating around non-towered aerodromes or approaching VFR reporting points
- runway excursions
- collision with wires and other obstacles that were known hazards to the pilot
- loss of tail rotor effectiveness during helicopter take-offs and landings
- landing gear retraction/extension mechanical discontinuities resulting in wheels-up landings or ground strikes
- loss of control following a partial power loss after take-off, or due to a crosswind on take-off or final approach.

Some unusual non-injury accidents and serious incidents in 2013 investigated by the ATSB included propeller separations, near collisions on the ground, and fuel contamination. There are some good lessons that all GA pilots can take out of these investigations:

- On climb following departure from Tyabb, Vic., the pilot of a Jabiru J430 reported the onset of vibration through the airframe and as a precaution, turned the aircraft back toward Tyabb. Shortly thereafter, the propeller separated from the aircraft and the pilot subsequently carried out a successful forced landing on sand flats to the south-east of the aerodrome. The pilot was not injured. The ATSB investigation found that most of the cap screws connecting the propeller mounting flange to the engine crankshaft had failed by bending fatigue fracture – principally

due to repeated relative movement between the mounted components. This movement was traced to a combination of an ineffective, multi-step torqueing method and the relaxation of tension within the crank–flange joint due to the compression of multiple layers of paint within the joint. It was also found that there were some anomalies within the maintenance documentation that related to these areas. After attempting to analyse the origin of the worsening vibration in the aircraft, the pilot correctly followed emergency procedures both before and after the propeller loss. The over-water return decision limited the risks associated with the forced landing, and the pilot effectively maintained control of the aircraft throughout the descent and landing. In July 2011, the manufacturer had improved the strength and reliability of the crank–flange joint by adding positive-location dowels in all new-production engines. However, that modification was not extended to earlier design assemblies, which included the accident aircraft. The current (revised) issue of the overhaul manual for the type of engine involves has an added, strong recommendation for inclusion of these dowels at the next full overhaul or at bulk strip of engines manufactured prior to July 2011. A broad requirement was also introduced to ensure that no paint, thread-locking compound or contaminants remain in the propeller flange joint. In addition, the fastener torqueing method has been amended to a single-step process in which the required torque is to be obtained dynamically while the fastener is being turned. (ATSB investigation AO-2013-046).

- The pilot of a Mooney M20 was preparing for a VFR flight from Canberra to Albury, NSW. As it had rained at Canberra Airport the night before, the pilot paid particular attention to conducting pre-flight fuel drains and checking for water. The pilot did not find any water in the fuel. The aircraft took off normally, and the pilot retracted the landing gear at about 100 ft AGL. Within seconds of retracting the gear, the engine stopped. The aircraft descended and landed on the runway heavily on the left wing and landing gear, with the propeller striking the ground. The aircraft was substantially damaged and the pilot suffered minor injuries. An inspection of the engine after the accident revealed water in the left tank, fuel system and fuel injector lines. The pilot reported to the ATSB that he contacted the aircraft manufacturer and was advised that incorrect re-sealing of the M20 series aircraft fuel tanks could allow 1 to 2 litres of water to be retained in the wing, which could not be drained (ATSB investigation AO-2013-092).
- A Cirrus SR22 was on approach to Kingaroy, Qld after a flight from Archerfield. At about 500 ft AGL, the pilot extended the flaps and shortly after, disconnected the autopilot. The pilot reported that the aircraft then pitched-up violently due to trim runaway. The autopilot pitch trim was trimming the aircraft for a nose-up position, even though the autopilot was disconnected. This required the pilot to use a large amount of forward physical force to maintain stable flight. He attempted to resolve the problem by pressing and holding the autopilot disconnect switch, however, this had no effect. The pilot decided to conduct a go-around. He then used the manual electric trim hat switch located on the control yoke in an attempt to trim the aircraft nose-down. This allowed the pilot to regain sufficient control of the aircraft and land safely at Kingaroy. On the basis of the evidence available to the ATSB, it was not possible to determine with any certainty the reason for the pitch-up event. This serious incident highlights the safety benefit to be gained from going around, which allowed the pilot time to troubleshoot and prepare for landing with the pitch trim difficulties (ATSB investigation AO-2013-126).
- A pilot was flying a Cessna 210 from Port Macquarie to Bankstown, NSW. The pilot regularly flew this route and was very familiar with the airspace. On this day, he was feeling unwell, so departed earlier than usual. The flight went as planned, with the aircraft arriving at the cruise level of 8,500 ft near Taree. The pilot requested and was issued a clearance to enter Class C controlled airspace at Williamtown. The pilot put the aircraft on autopilot, and listened to music through the radio whilst monitoring the aircraft. There was no further communication with the Cessna until the pilot called close to Bankstown, despite ATC trying to raise the pilot several times. The pilot had fallen asleep and re-entered Class C controlled airspace without a clearance prior to waking up again about 20 minutes later. Realising that he must have fallen asleep, he gathered his thoughts, checked the aircraft instruments, and realised he was in Class C airspace to the north of Brooklyn Bridge. In a state of shock, the pilot conducted a

spiral descent down to the Lane of Entry near Brooklyn Bridge. During the descent, he selected several ATC frequencies to listen for any calls regarding his aircraft, and then broadcast his position on the CTAF in case the aircraft posed a risk to other traffic in the area. Having not heard the aircraft mentioned on any of the selected radio frequencies, he continued the flight as planned with a safe arrival and landing at Bankstown. The pilot spoke to ATC at length after landing. The pilot reported that this was the first time he had experienced such an event and it took some time to recover. He realised that work pressures had influenced his decision to fly, when in hindsight he realised how tired and unwell he had been. He also reported that his sleep pattern had deteriorated over the last few years and he felt that this had contributed to the occurrence. He routinely had minimal sleep due to work commitments, but until now, it had never posed a problem. He also commented that conducting the same flight once or twice a week over many years may have allowed him to become too familiar with the airspace, and too reliant on the aircraft's autopilot and GPS (ATSB investigation AO-2013-155).

- The pilot of a de Havilland DH.82 Tiger Moth was taxiing at Sandy Beach, NSW to conduct circuits. The pilot taxied to the end of the runway and applied the brakes to conduct engine run-up checks. The pilot released the brakes and lined up on the runway heading and then applied full power for take-off. The aircraft accelerated down the runway. As the airspeed increased, the tail rose to the take-off position at about 200 m down the runway and at about 30 kt. Suddenly, the nose of the aircraft dropped and the aircraft flipped onto its back. An engineering inspection of the aircraft determined that the left main landing gear brake drum had evidence of corrosion, and the brake operating rod was found stiff to operate. When the brakes were applied and released, the left brake did not release fully. After the brake was cleaned and lubricated, the brake operated normally. The maintenance organisation reported to the ATSB that the left brake was probably partially engaged on take-off. This was the aircraft's first flight in more than 7 months and it was normally stored in a high corrosion environment (ATSB investigation AO-2013-190).

Take-off event involving a de Havilland DH.82 Tiger Moth (VH-RAY), near Coffs Harbour, New South Wales (ATSB investigation AO-2013-190)

- The driver of an ambulance received a call to meet a rescue helicopter at the Jurien Bay airstrip, WA. A few minutes later, the pilot of a Cessna 208 landed at Jurien Bay at the completion of a private flight, and parked at the northern apron in front of the Royal Flying Doctor Service (RFDS) terminal. The pilot left the engine running as he was about to pick up some parachutists. The ambulance arrived shortly after at the aerodrome to enter via the RFDS terminal access gate. The driver stopped the ambulance and unlocked the gate, cutting rope barriers that had been erected and were blocking ambulance access to the RFDS terminal. The ambulance entered the airport and proceeded towards the runway via the RFDS apron. The driver reported that the ambulance deviated around the Cessna, leaving about 14 m distance from the propeller. The Cessna pilot estimated the distance to be about 3 m. The ambulance then entered the runway and drove towards the helipad. While driving along the runway, the ambulance driver received another call advising that the rescue helicopter was at the Jurien Bay marina awaiting the ambulance for a patient transfer. He made a U-turn and returned via the same route, deviating around the stationary Cessna. The driver reported maintaining a safe distance, whereas the Cessna pilot reported that the ambulance passed within about 2 m of the aircraft's wingtip. This incident highlights the importance of understanding local procedures around non-controlled aerodromes, in particular having agreements between users of a facility (ATSB investigation AO-2014-002).

Sports aviation

Sports aviation includes gliding, parachute operations, private balloon operations and aerobatics in VH-registered aircraft. In 2013, there were 19 sport aviation aircraft involved in incidents, which was slightly below the average over the last 10 years. There were fewer accidents and fatal accidents than the previous year, although the number of serious incidents increased (Table 20).

Table 20: Occurrences involving general aviation aircraft conducting sports aviation, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	37	26	12	17	25	18	25	26	22	19
Serious incidents	3	1	1	5	3	4	7	11	9	16
Serious injury accidents	4	2	1	1	2	3	3	3	2	1
Fatal accidents	1	4	3	2	2	3	0	1	3	1
Total accidents	11	11	7	10	7	9	7	18	14	9
Number of people involved										
Serious injuries	4	2	1	1	2	4	4	3	3	2
Fatalities	1	4	4	3	3	3	0	1	4	1

Among the accidents reported to the ATSB in 2013 involving VH-registered sports aviation aircraft were two glider accidents, resulting in a fatality and serious injury respectively:

- During the final approach to land at Towrang (Carrick) airfield near Goulburn, NSW, the Schempp-Hirth Mini Nimbus glider was struck by a Blanik glider which had just been launched from the same direction runway. The Nimbus continued the approach and the Blanik collided with terrain. One crew member in the Blanik suffered fatal injuries, and the second crew member suffered serious injuries. The Blanik was destroyed and the Nimbus sustained minor damage. The Gliding Federation of Australia investigation into this accident found that the use of a common runway for winch launching and glider landings, limited visibility, and radio equipment problems on the Mini Nimbus contributed to a reliance on unalerted see-and-avoid principles to maintain aircraft proximity (ATSB occurrence 201304008).

- The pilot of a Rolladen Schneider Flugzeugbau LS7-WL glider attended the daily pilots' briefing at Benalla Airport, Vic. as part of his flight preparations. He initially planned to head to the north of Benalla but was advised that there would be better lift to the southeast of the airfield as indicated by the presence of cumulus clouds. The pilot then amended his planned flight to follow the cumulus clouds and lift to the south-east of Benalla. The glider was launched and climbed to about 4,500 ft AMSL, overhead the airfield. The pilot tracked towards a quarry and a series of small hills and then followed the cumulus clouds to the south-east. Once over the hills, the pilot reported that the wind changed from a south-easterly to a south-westerly direction and the cumulus clouds dissipated and the lift disappeared. The pilot observed that the glider was not within range of a return to Benalla, and commenced looking for a suitable field for an out landing. The pilot identified a field about 1 to 2 NM ahead in a valley. When at about 500 ft AGL, the pilot observed that the surface had rocks and holes and quickly chose an alternative field. The alternative field was perpendicular to the planned landing area and there was a row of trees on the approach end of the field and a ditch at the far end. The pilot conducted an approach to the field with the glider passing over the trees at about 50 ft AGL before landing heavily. The pilot sustained a serious injury due to the hard landing and the glider was substantially damaged (ATSB investigation AO-2013-224).

In 2013, sports aviation accidents and serious incidents that did not result in injuries most often involved aircraft proximity issues near non-controlled aerodromes. In these cases, near misses or collisions occurred because one or both pilots did not hear the other broadcast on the CTAF, and were relying on unalerted see-and-avoid principles for situational awareness. Three of these accidents and serious incidents were investigated by the ATSB:

- Two glider clubs were conducting gliding operations at Tocumwal, NSW. A Grob Twin Astir glider from one gliding club was towed airborne, however, after a number of orbits looking for rising air the pilot decided to return to the circuit and land. A few minutes later, a Cessna 150 took off towing a glider from the other club. Following the release of the glider, the Cessna pilot turned left and tracked for a left downwind on runway 36L. Witnesses on the ground reported hearing both pilots making all necessary CTAF broadcasts. Just as the Cessna touched down on runway 36L, the pilot felt a heavy jolt on the top of the cockpit and heard a loud noise. Immediately, he saw the windscreen fill with the underside of a glider (the Twin Astir). He observed the glider continue down the runway at about 5 to 10 ft above ground level. The Cessna pilot was uninjured, and on exiting the aircraft, observed a wheel contact print on the top of the aircraft. The pilot of the Twin Astir was uninjured and landed the glider well down the runway. On exiting the glider, the pilot observed damage on the left wing and fuselage (ATSB investigation AO-2013-048).

Collision on runway between a Grob G103 Twin Astir glider (VH-UIZ) (pictured) and a Cessna 150 (VH-ROZ), at Tocumwal Airport, New South Wales (ATSB investigation AO-2013-048)

- A Janus glider took off from runway 27 at Bacchus Marsh airstrip, Vic. to conduct a local flight. During the flight, the wind direction at the airstrip changed, resulting in runway 19 becoming the active runway. At about the same time, the pilot of a McDonnell Douglas 500N helicopter was conducting circuits. He was on his fifth circuit and had reported broadcasting a call on the CTAF immediately prior to turning base for runway 19. The Janus had returned to Bacchus Marsh airstrip by this stage and joined the downwind leg of the circuit for runway 19. After ensuring the radio volume was turned up, the pilot reported broadcasting a downwind call on the CTAF. Towards the end of the downwind leg, while descending through about 500 ft, the passenger in the front seat of the Janus observed the helicopter in his 12 o'clock position. The pilot then observed the helicopter below him on a diagonal track for runway 19, passing about 100 ft below the glider. He further reported that he did not hear any calls from the helicopter pilot on the CTAF. When established on late base, at 500 ft, the pilot of the helicopter reported sighting the Janus on downwind in his 10 o'clock position, about 100 ft above and 100 m away. The pilot stated that he did not believe there was any risk of a collision with the glider and continued with the circuit. He reported that he did not hear a downwind call from the Janus pilot (ATSB investigation AO-2013-108).
- A PZL Bielsko 51 glider was winched at Gympie, Qld. About 20 minutes later, the glider entered the circuit on downwind at about 900 ft AGL, and the pilot broadcast a downwind call on the CTAF. A Bell 206 helicopter was conducting circuits from runway 32 for flight training. The instructor in the helicopter broadcast on the CTAF when turning base, and heard the downwind call made by the glider pilot. At that time he sighted the glider on mid-downwind. Soon after, the glider pilot broadcast that he was turning base, then commenced a diagonal base leg on about a 45° angle from the downwind leg. The helicopter turned onto final and the instructor broadcast on the CTAF. The instructor reported that at this time, he assumed the glider was on late downwind or base leg. The glider pilot reported that he also broadcast a final call, but neither pilot heard the other pilot's finals broadcast. About 90 seconds later, the instructor in the helicopter sighted the glider to his right, at about the same height and about 10 m away. The glider pilot also observed the helicopter to his left and slightly above. In response, he lowered the nose of the glider to increase the airspeed to stay below the helicopter. The glider then landed on the grass to the left of the runway. The instructor took control of the helicopter from the student, conducted a clearing turn and subsequently landed on the sealed runway (ATSB investigation AO-2013-220).

Foreign general aviation

There are generally very few accidents and serious incidents involving foreign-registered GA aircraft in Australia, although about 16 incidents are reported each year (Table 21).

Table 21: Foreign registered general aviation aircraft occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	7	16	16	18	25	14	12	13	18	18
Serious incidents	1	1	0	1	0	0	1	0	0	4
Serious injury accidents	0	0	0	0	0	0	0	0	2	0
Fatal accidents	1	0	0	0	0	0	1	0	0	0
Total accidents	1	0	1	1	1	0	2	0	2	1
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	2	0
Fatalities	2	0	0	0	0	0	1	0	0	0

Almost all of the 18 incidents reported to the ATSB in 2013 involved airspace issues. One of these was investigated by the ATSB:

- A United States-registered Mitsubishi MU-2 was being ferried from the United States to Australia via several stops. The aircraft took off from Honiara in the Solomon Islands with two pilots on board bound for Essendon, Vic. via Townsville, Qld. Shortly after take-off from Townsville, both pilots received a considerable amount of static in their headsets. Townsville ATC then instructed the crew to transfer to the Townsville Approach frequency. One of the pilots read back the instruction, but ATC advised that he was transmitting carrier wave only (no voice communications were heard). About 5 minutes after the aircraft departed, Townsville ATC offered the crew the option of returning to Townsville. The flight crew reported that they could hear the transmissions made by Townsville ATC, but were unable to return as the fuel quantity in each wing tip tank was in excess of the maximum landing limitation and the aircraft was carrying additional fuel in the ferry tank. The crew were unable to advise Townsville ATC of this as the aircraft's very high frequency (VHF) radios were now inoperable. Consequently, the crew elected to continue the flight as per the submitted flight plan. The crew attempted to resolve the radio problem, but without success. Townsville ATC, Brisbane Centre ATC and Melbourne Centre ATC also continued attempts to establish communications with the crew. When about 230 NM north of Essendon, communications with ATC were re-established. The crew were not in normal communications with ATC for about 3 hours and 35 minutes. An examination of the radio determined that water leakage from a small access door had corroded two main radio isolator breakers/switches, which subsequently resulted in the radio failure. This incident shows how important it is that ATC is made aware of any problems as soon as possible. This provides ATC with sufficient time to manage a situation, rather than having to react when an issue has developed into a major problem. In the event of a communications failure, it is important that pilots follow the appropriate procedure, and if communications cannot be re-established, consider using alternative methods such as mobile telephones (ATSB investigation AO-2013-066).

There were four serious incidents and one accident in 2013 involving foreign-registered GA aircraft operating in Australia, none of which resulted in serious injuries or fatalities. The accident involved a RPA that struck a bird during cruise, resulting in the RPA losing stability and colliding with terrain. The serious incidents primarily involved near misses or runway incursions when operating near non-controlled aerodromes. The ATSB investigated one of these serious incidents, where a Dutch-registered glider had a near collision near Griffith, NSW with a Beech King Air

conducting an aeromedical retrieval flight. This serious incident is discussed further in *Emergency medical services* on page 45.

Other general aviation

Between 2004 and 2013, over 7,500 aviation safety occurrences were reported to the ATSB that involved an Australian-registered GA aircraft, but no information was provided on the type of flying operation. In many occurrences involving a GA aircraft where the type of flying operation was not known, the ATSB was notified by someone other than the pilot of the aircraft involved (such as ATC, the public, pilots of nearby aircraft, or aerodrome-based staff). The number of occurrences involving 'unknown' GA aircraft has decreased by about 30 per cent over the last 5 years, due to improvements in reporting detail and data collection methods. The large number of unknown GA aircraft involved in reportable occurrences has been, in part, related to the abolition of mandatory flight plans for all aircraft since the mid 1990's, which is reflected in most of these occurrences being airspace-related (airspace infringements, aircraft proximity issues, non-compliance with published information, ATC instructions, or standard operating procedures). Other reasons that an operation type might not be recorded for an occurrence include no aircraft being affected (some ground operation-related occurrences), or where aerodrome officers have located dead wildlife on an aerodrome (suspected animal or bird strike).

Recreational aviation

Recreational aviation covers a very diverse range of aircraft types, including factory and amateur-built fixed-wing aeroplanes and motorised gliders, weight shift hang gliders, trikes, paragliders and powered parachutes, and gyrocopters. Aircraft involved in recreational aviation, as defined by the ATSB, are registered by an RAAO with an Australian non-VH- registration.

Over the last 10 years, reporting of safety incidents to the ATSB by recreational aviation pilots and organisations has increased tenfold due to both the growth in recreational flying, and improving awareness among RAAOs and pilots of the need to report safety matters to the ATSB. As a result, some of the relatively low numbers of occurrences towards the start of the 10 year period used in this report can be accounted for by under-reporting of accidents and incidents.

The number of reported accidents and serious incidents reported in 2013 was lower when compared to 2012 (Table 22). Unfortunately, the number of aircraft involved in fatal accidents doubled. Accidents involving recreational aircraft are not usually investigated by the ATSB, but the RAAO may conduct its own independent investigation.

Table 22: Recreational aviation (non-VH registered) aircraft occurrences, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	3	4	10	48	66	44	72	91	105	114
Serious incidents[17]	0	2	5	12	19	8	17	9	42	33
Serious injury accidents	1	1	0	4	3	4	9	12	22	7
Fatal accidents	9	6	4	16	2	10	6	6	6	12
Total accidents	10	7	4	29	41	41	57	60	84	71
Number of people involved										
Serious injuries	3	1	2	8	4	4	12	15	23	8
Fatalities	10	6	4	21	3	11	7	8	9	15

[17] Includes two serious incidents involving model aircraft.

Rate of aircraft involved[18]										
Accidents per million hours	39.8	28.9	16.2	112.5	147.1	133.6	200.2	201.1	N/A	N/A
Fatal accidents per million hours	35.8	24.8	16.2	62.1	7.2	32.6	21.1	20.1	N/A	N/A

There were 12 fatal accidents in recreational aviation in 2013 resulting in 15 fatalities, and a further seven aircraft were involved in an accident where occupants were seriously injured (Figure 18).

Figure 18: Recreational aviation occurrences and injuries, 2004 to 2013

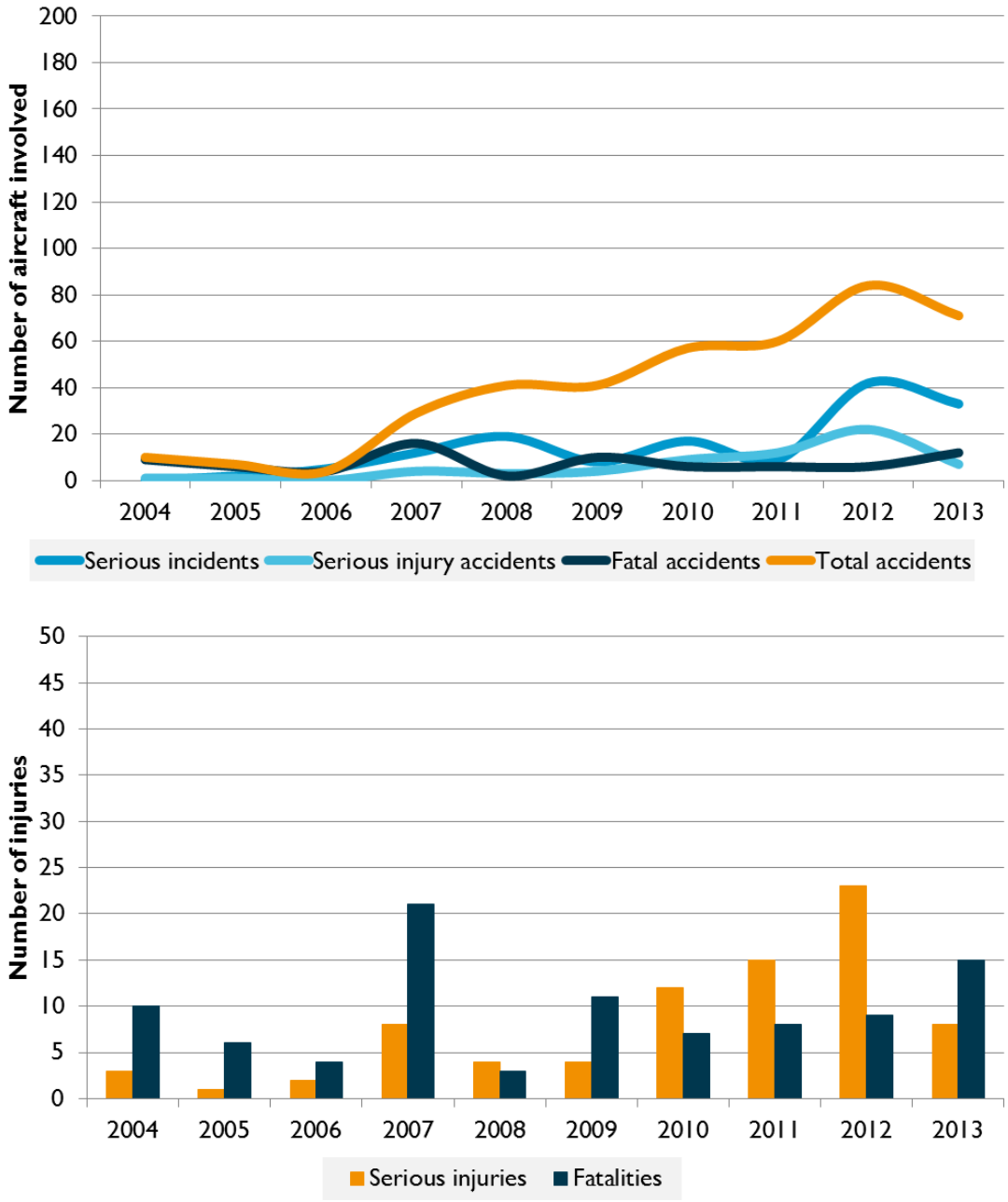
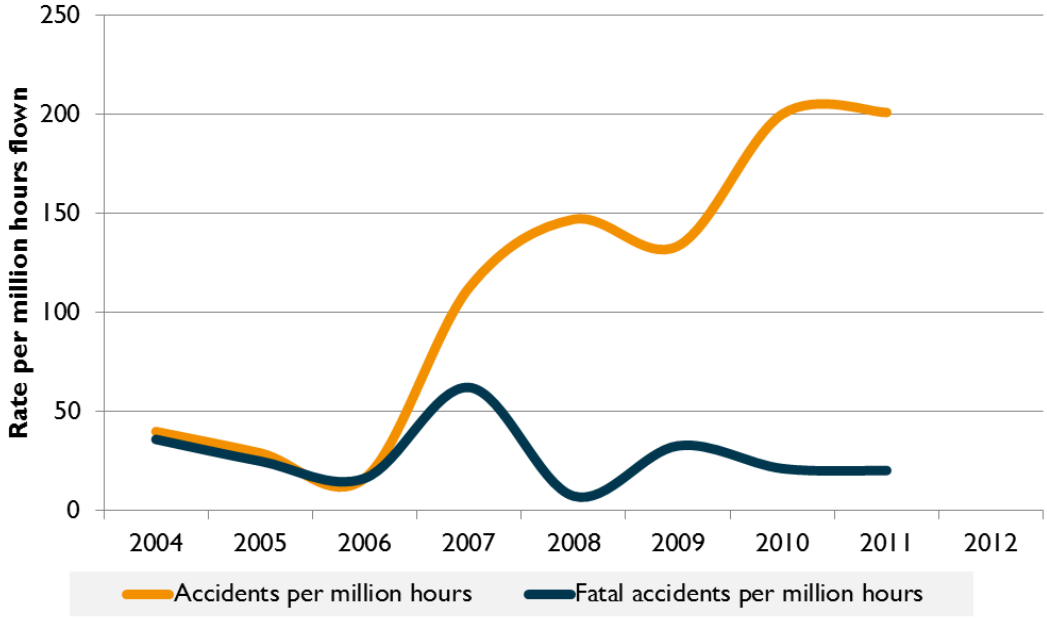


Figure 19 shows that the accident rate in recreational aviation has increased dramatically since 2006. While this increase is likely to be due to better reporting of accidents involving these aircraft to the ATSB, the recreational aviation accident rate in 2011 (about 200 accidents per million hours

[18] Data was only available from 2004 to 2011.

flown) was higher than any other type of flying in Australia. Recreational aeroplanes (those aircraft registered with Recreational Aviation Australia (RA-Aus)) made up the largest proportion of recreational flying hours, and were also involved in 71 per cent of all recreational aviation accidents in the 2004 to 2013 period, and 51 per cent of the fatal accidents. Although the recreational aeroplane accident rate over this period was higher than all other types of flying, gyrocopters had a higher fatal accident rate when considering hours flown.

Figure 19: Recreational aviation accident and fatal accident rate (per million hours flown), 2004 to 2011



The fatal and serious injury accidents involving recreational aircraft in 2013 are described in the sections below. For many of these occurrences, very few details were provided to the ATSB regarding the circumstances of the accident or serious incident. Increasing the level and quality of safety reporting in GA and recreational flying is a major challenge for the ATSB and is one of nine *SafetyWatch* priorities in improving Australian aviation safety.

There were 85 recreational aircraft involved in accidents or serious incidents that did not result in fatal or serious injuries that were reported to the ATSB in 2013. Almost all of these occurrences involved fixed-wing, single-engine recreational aeroplanes, with four occurrences involving a gyrocopter. Many involved common themes, which were also seen in other types of GA operations:

- power loss or engine failure during initial climb or cruise, leading to a forced landing
- engine failure on approach, due to mechanical failure or fuel mismanagement
- loss of control or collision with an obstacle on final approach to land, usually due to windshear or a crosswind
- wirestrikes
- animal strikes during take-off
- landing gear mechanical failure during the landing roll or following a hard landing, resulting in a ground strike or a loss of directional control and runway excursion
- runway incursions or near-misses between aircraft in the vicinity of non-controlled aerodromes, due to pilots not hearing the other pilot's situational broadcasts on the CTAF
- runway excursions due to incorrect aircraft configuration during the landing roll, or landing long.

Some unusual accidents reported in 2013 included a fire on the ground during refuelling due to static electricity discharge, and a runway excursion which occurred when a pilot landed on a sloping grass runway that was wet.

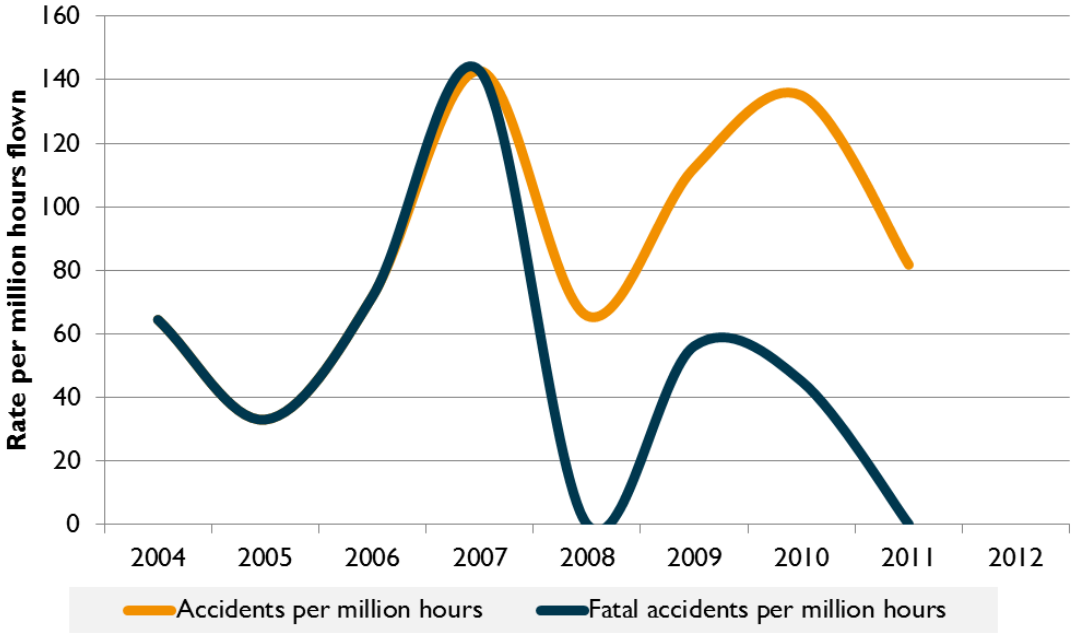
Gyrocopters

Over the last 10 years, six incidents, five serious incidents and 38 accidents have been reported to the ATSB involving gyrocopters (Table 23). While incident reporting rates have been very low over this period, there was a notable increase in reporting of gyrocopter accidents by the Australian Sport Rotorcraft Association (ASRA) from 2006. Figure 20 shows the rate of accidents and fatal accidents involving gyrocopters over the 2004 to 2011 period (for which flying hours were available).There was a 61 per cent increase in flying activity over this period. On average, gyrocopters had an accident rate (90 accidents per million hours flown) that was significantly lower than private/business/sport operations and similar to the accident rate for all GA operations (about 91 per million hours flown). On the other hand, gyrocopter operations had the highest fatal accident rate of all types of flying in most years where fatal accidents occurred (47 per million hours flown, double that of both VH-registered private/business and sport/gliding operations and recreational weight shift operations, and 1.7 times higher than recreational aeroplanes).

Table 23: Occurrences involving recreational gyrocopter operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	0	0	0	1	1	0	1	0	0	3
Serious incidents	0	0	0	0	2	0	0	1	1	1
Serious injury accidents	0	0	0	0	0	0	2	3	1	2
Fatal accidents	2	1	2	4	0	2	2	0	3	1
Total accidents	2	1	2	4	2	4	6	4	6	7
Number of people involved										
Serious injuries	0	0	1	3	0	0	2	3	2	2
Fatalities	2	1	2	4	0	2	2	0	4	2
Rate of aircraft involved										
Accidents per million hours	64.4	32.9	71.7	142.8	65.6	112.3	135.1	81.8	N/A	N/A
Fatal accidents per million hours	64.4	32.9	71.7	142.8	0.0	56.1	45.0	0.0	N/A	N/A

Figure 20: Accident rate for recreational gyrocopter operations (per million hours flown), 2004 to 2011



There were seven accidents and one serious incident reported in 2013 involving gyrocopters. One of these accidents was fatal, and two resulted in serious injuries. These accidents are described below:

- During an approach to Biloela, Qld beside powerlines, a Modified Dominator gyrocopter struck an unseen spur line before colliding with terrain. The gyrocopter was destroyed and the pilot was seriously injured. The pilot was conducting a precautionary landing to check the operation of the gyrocopter's engine cooling system (ATSB occurrence 201306248).
- During cruise near Townsville, Qld, a gyrocopter collided with terrain resulting in substantial damage and serious injuries to the pilot. It was reported that as the pilot applied full power, the slipper clutch malfunctioned resulting in a loss of rotor revolutions per minute (ATSB occurrence 201306820).
- A MT-03 gyrocopter collided with terrain near Kinglake, Vic. on a return flight from the Yarra Valley Conference Centre. Both the pilot and a passenger were fatally injured (ATSB occurrence 201312264).

More information on gyrocopter operations in Australia is available from ASRA at www.asra.org.au.

Recreational aeroplanes

Recreational aeroplanes include all non-weight-shift controlled aircraft registered with RA-Aus involved in safety incidents and accidents that are reported to the ATSB. Reporting of safety incidents involving recreational aeroplanes has improved significantly in recent years, as shown in Table 24. Between 2004 and 2013, there were seven times as many incidents and nine times as many accidents reported to the ATSB, with flying activity increasing by 67 per cent over this period.

Figure 21 shows the rate of accidents and fatal accidents involving recreational aeroplanes over the 2004 to 2011 period (for which flying hours were available). Despite the increase in flying activity, the accident rate has increased for several consecutive years. In 2011, the recreational aeroplane accident rate in Australia (about 305 per million hours flown) was higher than for any other type of flying, including higher risk GA operations such as aerial agriculture (179 per million

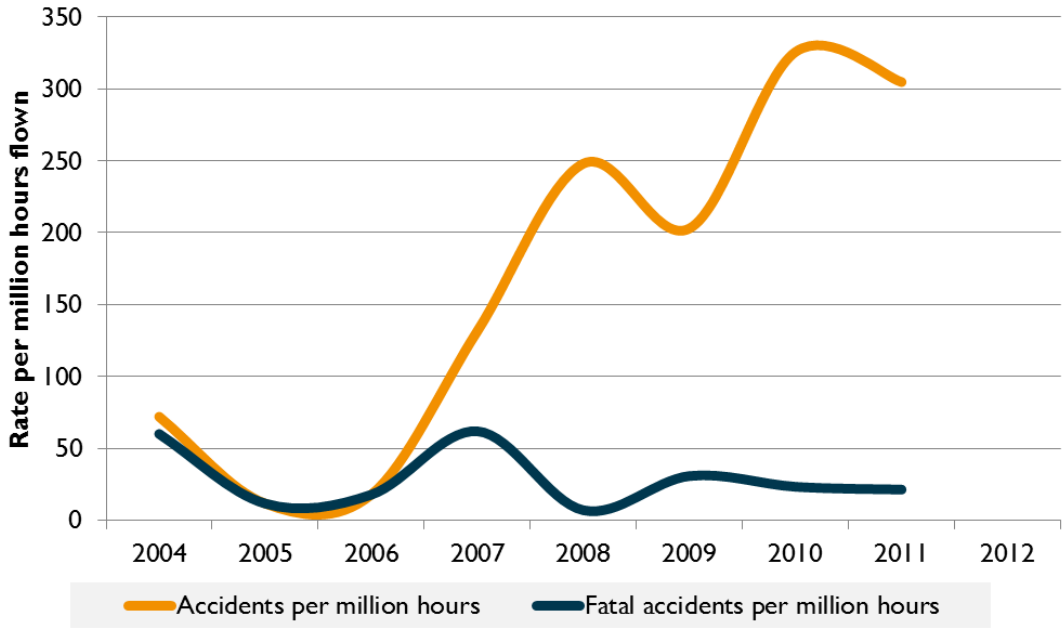
hours flown). The accident rate across the period was higher than that for private/business/sport flying (156 per million hours flown, excluding gliding, for 2004-2012).

The fatal accident rate involving recreational aeroplanes over the 2004 to 2011 period (29 fatal accidents per million hours flown) was slightly higher than for comparable private/business/sport operations (24 per million hours flown, excluding gliding for 2004-2012).

Table 24: Occurrences involving recreational aeroplane operations, 2004 to 2013[19]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	2	2	9	43	62	42	68	87	91	101
Serious incidents	0	1	4	11	16	8	17	7	34	28
Serious injury accidents	1	0	0	2	2	4	3	4	4	4
Fatal accidents	5	1	2	8	1	5	3	3	1	9
Total accidents	6	1	2	17	36	33	42	43	50	56
Number of people involved										
Serious injuries	3	0	1	3	2	4	6	5	4	5
Fatalities	6	2	2	12	2	5	4	5	2	10
Rate of aircraft involved										
Accidents per million hours	72.0	11.6	17.7	131.5	248.1	203.0	325.8	304.8	N/A	N/A
Fatal accidents per million hours	60.0	11.6	17.7	61.9	6.9	30.8	23.3	21.3	N/A	N/A

Figure 21: Accident rate for recreational aeroplane operations (per million hours flown), 2004 to 2011[19]



In 2013, there were 56 accidents and 28 serious incidents reported to the ATSB involving recreational aeroplanes. Nine of these accidents were fatal, and four resulted in serious injuries. These accidents are described below:

[19] Includes RA-Aus registered motorised gliders.

- A Howard Hughes GR-912 Lightwing collided with terrain near George Town, Tas. The pilot, who was the sole occupant on board, was fatally injured (ATSB occurrence 201300135).
- An Aeroprakt A22 Foxbat collided with terrain near Heck Field, Qld. Both occupants suffered serious injuries, and the aircraft was substantially damaged. The aircraft was equipped with a ballistic recovery system (ATSB occurrence 201300523).
- A Skyfox CA25 collided with terrain north of Caboolture, Qld and was destroyed. The pilot, who was the sole occupant, was fatally injured (ATSB occurrence 201300889).
- A Maverick aeroplane collided with terrain near Texas, Qld. The pilot suffered fatal injuries and the aircraft was substantially damaged (ATSB occurrence 201301147).
- A Pioneer 200 collided with terrain near Ouyen, Vic. and was destroyed in a post-impact fire. Both occupants were fatally injured (ATSB occurrence 201301151).
- While conducting aerial mustering, a P92 aeroplane collided with terrain near Jackson, Qld. The pilot was fatally injured and the aircraft was substantially damaged (ATSB occurrence 201302435).
- A Van's RV-12 amateur-built aeroplane collided with terrain shortly after take-off from Lismore, NSW. The pilot was fatally injured, and the ATSB assisted the NSW Police Force and the NSW Coroner to recover data from the aircraft's avionics system (ATSB investigation AE-2013-069).
- A Morgan Super Diamond collided with terrain near Taree, NSW. The pilot was fatally injured (ATSB occurrence 201303863).
- A Howard Hughes GR-912 Lightwing had an engine failure during a flight near Port Augusta, SA. The pilot conducted a forced landing in a nearby paddock. The aircraft was substantially damaged and the pilot suffered minor injuries (ATSB occurrence 201307024).
- During initial climb from The Oaks, NSW, the engine of a Jabiru LSA aeroplane did not develop full power. The engine subsequently failed during the circuit, and the pilot attempted to make a forced landing back on the runway. The aircraft collided with trees, substantially damaging the aircraft, and resulting in minor injuries to the pilot and serious injuries to the passenger (ATSB occurrence 201309076).
- A Storm 300 collided with terrain near Bundaberg, Qld, fatally injuring the pilot (who was the sole person on board) (ATSB occurrence 201309077).
- A recreational aircraft collided with terrain near Mudgee, NSW, seriously injuring the pilot. The type of aircraft was not reported, and although it had an RA-Aus registration number, it was reported that the aircraft was not currently registered with RA-Aus, and that the pilot was not licenced (ATSB occurrence 201310344).
- A Savannah aircraft collided with terrain near an oil rig west of Moomba, SA. The pilot received fatal injuries. Prior to the accident, the pilot was mustering cattle. The ATSB provided assistance to RA-Aus to download data from a portable GPS unit that was recovered from the aircraft (ATSB investigation AE-2013-222).

More information on recreational aeroplane operations in Australia is available from RA-Aus at www.raa.asn.au.

Weight shift

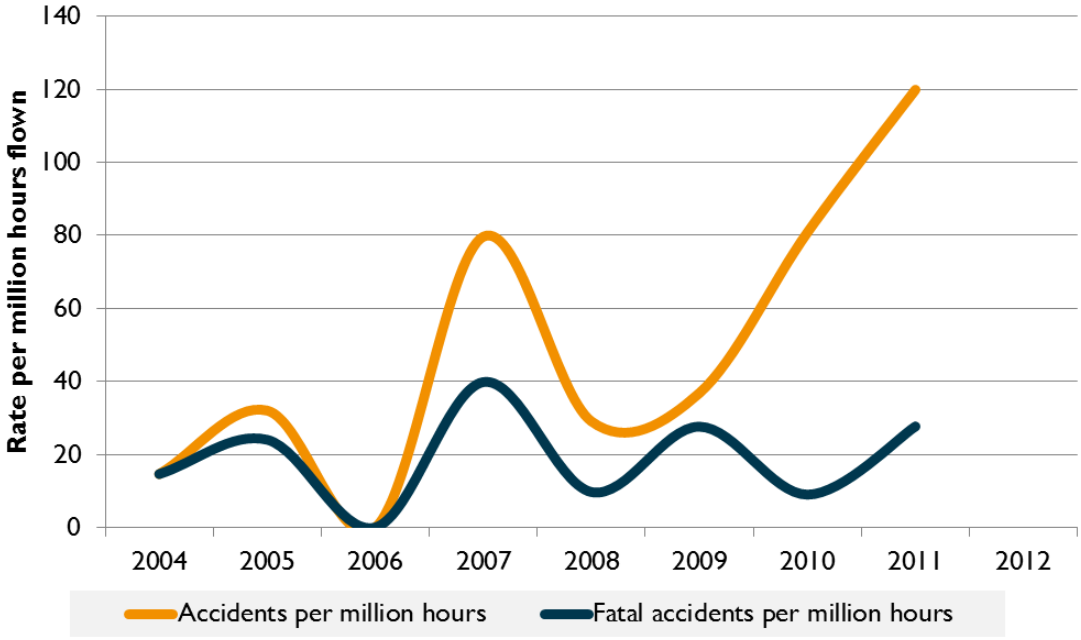
Weight shift aircraft refer to hang gliders, paragliders, powered parachutes, and weight-shift trikes and microlights. Over the last 10 years, 43 incidents, 13 serious incidents and 79 accidents have been reported to the ATSB involving weight shift aircraft (Table 25). Most of these aircraft were registered with the Hang Gliding Federation of Australia (HGFA), with some registered with RA-Aus. Figure 22 shows the rate of accidents and fatal accidents involving weight shift aircraft over the 2004 to 2011 period (for which flying hours were available). Weight shift activity (as reported by the HGFA and RA-Aus) fell over this period, from about 137,000 hours in 2004 to about 108,000 hours in 2011. This may have contributed to increasing accident and fatal accident rates

for weight shift aircraft over this period, although on average, these types of aircraft had the lowest accident rates of all types of recreational flying, and considerably lower than private/business/sport operations.

Table 25: Occurrences involving recreational weight shift operations, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of aircraft involved										
Incidents	1	2	1	4	3	2	3	3	14	10
Serious incidents	0	1	1	1	1	0	0	1	5	3
Serious injury accidents	0	1	0	2	1	0	4	5	17	1
Fatal accidents	2	3	0	4	1	3	1	3	2	2
Total accidents	2	4	0	8	3	4	9	13	28	8
Number of people involved										
Serious injuries	0	1	0	2	2	0	4	7	17	1
Fatalities	2	3	0	5	1	4	1	3	3	3
Rate of aircraft involved										
Accidents per million hours	14.6	32.0	0.0	79.7	29.1	36.8	80.8	119.9	N/A	N/A
Fatal accidents per million hours	14.6	24.0	0.0	39.8	9.7	27.6	9.0	27.7	N/A	N/A

Figure 22: Accident rate for recreational weight shift operations (per million hours flown), 2004 to 2011



There were eight accidents and two serious incidents reported in 2013 involving weight shift aircraft. One of these accidents resulted in a serious injury, and two resulted in fatalities. Each of these are described below:

- An RA-Aus registered Airborne Edge trike collided with water at Tuggerah Lakes, NSW. The pilot and joy flight passenger were fatally injured and were unable to be found (ATSB occurrence 201302118).

- The pilot was conducting a pre-purchase flight of a RA-Aus registered Airborne Edge weight-shifter microlight, with the owner of the aircraft following behind in a gyrocopter. The owner observed the Edge depart level flight at a steep nose-down angle before colliding with terrain near Darwin. The pilot received fatal injuries. The weather was reported as not contributing to the accident (ATSB occurrence 201309734).
- A HGFA-registered Airborne Edge collided with terrain during approach to parallel runway 30 at Wagga Wagga Airport following an abandoned landing on runway 23. The pilot suffered serious injuries, but the passenger was not injured. The trike was substantially damaged (ATSB occurrence 201304851).

More information on weight shift aircraft in Australia is available from the HGFA at www.hgfa.asn.au, and RA-Aus at www.raa.asn.au.

Occurrences by aircraft type

This section explores trends in occurrences by the type of aircraft involved, and the type of operation being conducted. It looks primarily at the rate of accidents within each type of operation, in relation to the number of hours flown by the type of aircraft within that category.

Of the 15,247 aircraft on the Australian civil aircraft (VH-) register at the time of writing, fixed-wing aeroplanes accounted for 84 per cent of all aircraft (11,527 powered fixed-wing aeroplanes, 239 motorised gliders and 998 unpowered gliders). Rotary-wing aircraft accounted for 14 per cent (2,100 aircraft). The remaining two per cent (382 aircraft) were balloons. Australian-registered recreational aircraft are additional to these figures. There were 5,211 aircraft registered with Recreational Aviation Australia (RA-Aus) in mid-2013 (4,363 aeroplanes and motorised gliders and 848 weight shift aircraft), and 259 gyrocopters registered with the Australian Sport Rotorcraft Association (ASRA) at the time of writing. Further to this figure are weight-shift aircraft registered by the Hang Gliding Federation of Australia (HGFA).

In this section:

- *aeroplanes* refers to all manned, VH- registered powered fixed-wing aircraft, and to recreational powered aeroplanes registered by RA-Aus
- *balloons* refers to all manned, VH- registered hot air balloons and lighter-than-air craft, including dirigibles
- *helicopters* refers to all manned, VH- registered rotary-wing aircraft
- *gliders* refers to all manned, VH- registered non-powered fixed-wing aircraft, and manned, VH-registered and non-VH- registered powered gliders
- *gyrocopters* refers to rotary-wing aircraft registered with ASRA, marked with a G- registration
- *remotely piloted aircraft* refers to unmanned fixed-wing, rotary-wing, and lighter-than-air craft that are controlled by a ground-based operator. These aircraft may be VH- registered or not registered by CASA.
- *weight shift* refers to manned aircraft which are controlled by human movement. They include hang gliders, paragliders, powered parachutes, weight-shift trikes and microlights. These aircraft may be registered with HGFA, marked with a T1- or T2- registration, or with RA-Aus marked with a 32- registration.

As flying activity data is only available for some of these types of aircraft, accident rates are only provided for aeroplanes, helicopters, and recreational aircraft types (recreational aeroplanes, gyrocopters, and weight-shift aircraft).

Differences in accidents between operation groups and aircraft type

There are considerably more accidents in Australia involving aeroplanes than other aircraft types. In the last 2 years as reporting of recreational aircraft accidents to the ATSB has improved, recreational aeroplanes have been involved in a similar number of accidents to general aviation aeroplanes. In 2013, there were about twice as many fatal recreational aviation accidents than were recorded in 2012 (Table 26).

Table 26: Number of accidents involving Australian-registered aircraft, by aircraft type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Aeroplanes										
Air transport	12	12	10	17	23	9	20	16	9	8
General aviation	97	78	58	85	84	80	84	73	60	59
Recreational	6	1	2	17	36	33	42	43	50	56
Balloons										
Air transport	0	0	0	0	0	0	0	0	0	1
General aviation	1	0	1	2	3	3	2	3	1	0
Helicopters										
Air transport	4	0	1	5	6	1	3	5	4	5
General aviation	34	31	25	25	34	34	36	25	27	24
Gliders										
General aviation	10	9	6	5	4	3	3	12	12	8
Recreational	0	1	0	0	0	0	0	0	0	0
Gyrocopters										
Recreational	2	1	2	4	2	4	6	4	6	7
Remotely Piloted Aircraft										
General aviation	0	0	0	0	0	0	0	0	0	1
Weight Shift										
Recreational	2	4	0	8	3	4	9	13	28	8

Helicopters were involved in about 28 per cent of all general aviation (GA) accidents and 29 per cent of fatal accidents in the last 10 years, even though they accounted for 14 per cent of the Australian VH-registered fleet and flew far less hours than aeroplanes. Recreational aircraft contributed an even larger proportion of the total number of fatal accidents. Between 2004 and 2011, 18 per cent of all accidents and 29 per cent of all fatal accidents in Australian aviation involved recreational aircraft, even though they contributed just nine per cent of the recorded hours flown by aircraft in Australia over this period (Table 27).

Table 27: Number of fatal accidents involving Australian-registered aircraft, by aircraft type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Aeroplanes										
Air transport	0	2	1	1	2	0	1	2	1	1
General aviation	6	10	12	9	18	7	8	6	14	12
Recreational	5	1	2	8	1	5	3	3	1	9
Balloons										
Air transport	0	0	0	0	0	0	0	0	0	1
General aviation	0	0	0	0	0	0	0	0	0	0
Helicopters										
Air transport	0	0	0	1	1	0	0	0	0	0
General aviation	4	3	4	2	2	8	4	9	4	2
Gliders										
General aviation	1	3	3	1	2	1	0	1	2	1
Recreational	0	1	0	0	0	0	0	0	0	0
Gyrocopters										
Recreational	2	1	2	4	0	2	2	0	3	1
Remotely Piloted Aircraft										
General aviation	0	0	0	0	0	0	0	0	0	0
Weight Shift										
Recreational aircraft	2	3	0	4	1	3	1	3	2	2

Collision with terrain involving an Ayres S2R Thrush (VH-JAY), near Hyden, Western Australia (ATSB investigation AO-2013-183)

Differences in accidents between specific operation types and aircraft types

When flying activity is considered, the accident rate involving helicopters in almost all types of operations is higher than for aeroplanes conducting the same type of operation (Table 28). In recreational aviation, the accident rate for gyrocopters was lower than the helicopter accident rate for private/business operations, and was comparable to that for flying training. The accident rate for recreational aeroplanes was higher than for aeroplanes in all operation types, while the accident rate for weight shift aircraft was relatively low.

The fatal accident rate over the 2004 to 2012 period was highest for gyrocopters, followed by helicopters used for private/business flying. It was lowest for fixed-wing flying training, and for all types of charter operations.

When comparing the accident rate of aircraft types[20] by operation type, there is significant difference between air transport (charter), GA, and recreational aviation (Table 28 and Figure 23). These differences are discussed below.

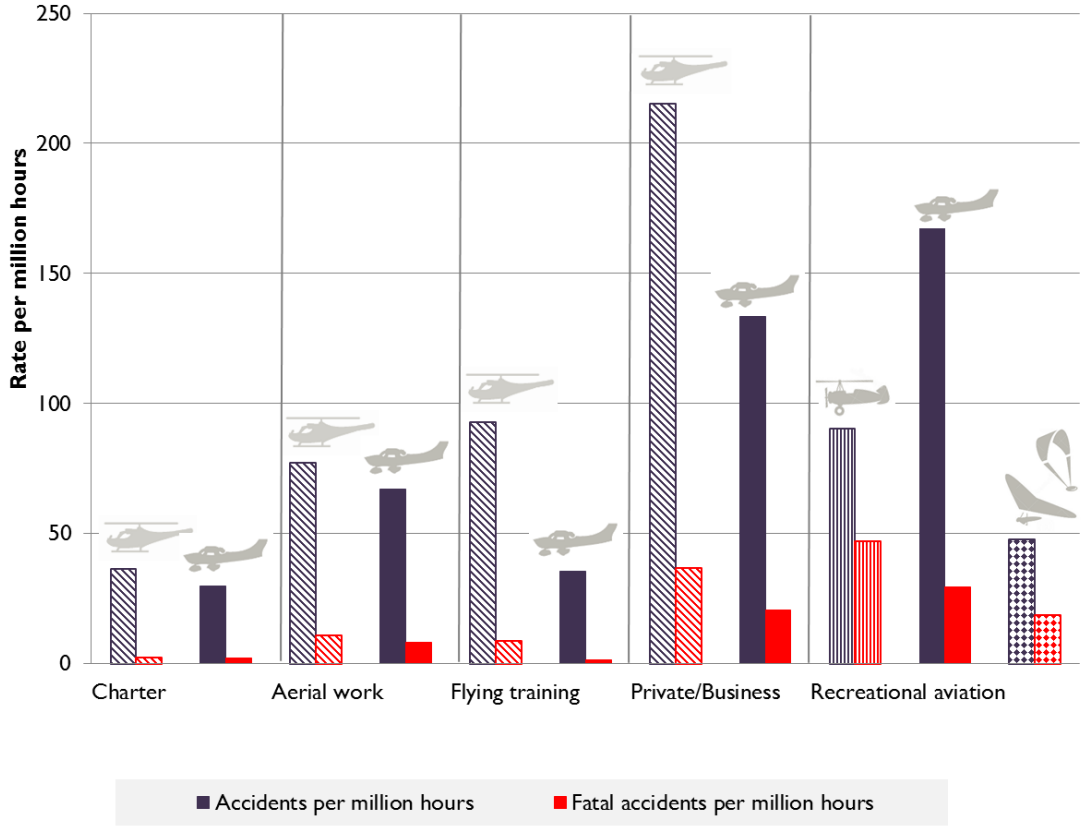
Table 28: Accidents, fatal accidents, and number of fatalities by operation type and aircraft type, 2004-2012[21]

Operation	Aircraft type	Accidents per million hours	Fatal accidents per million hours
Charter	Helicopters	36.6	2.5
	Aeroplanes	29.5	2.2
	Balloons	-	-
Aerial work	Helicopters	77.2	11.1
	Aeroplanes	67.1	8.3
Flying training	Helicopters	93.0	8.7
	Aeroplanes	35.4	1.4
Private/business	Helicopters	215.5	37.0
	Aeroplanes	133.3	20.5
	Balloons	1,096.0	-
Recreational aviation	Gyrocopters	90.3	47.0
	Aeroplanes	182.9	29.3
	Weight Shift	47.8	18.9

[20] Activity data was only available for aeroplanes, helicopters, balloons, gyrocopters, recreational aeroplanes, and weight-shift aircraft.

[21] Data considers the period 2004 to 2012 for all operation types except for recreational aviation, where flying activity data was only available for the 2004 to 2011 period. The number of fatalities involving recreational aircraft has been adjusted accordingly to reflect this period. Balloon accident rates are not presented.

Figure 23: Rate of accidents and fatal accidents by operation and aircraft type



Over the 2004 to 2012 period, all air transport using helicopters were charter operations, so the only air transport comparison for aircraft types provided here is for charter.

Charter

Aeroplanes and helicopters involved in charter air transport operations had similar accident rates (about 30 versus 37 accidents per million hours flown over the 2004 to 2012 period).

The rate of fatal accidents over this period involving helicopters was lower than for aeroplanes (2.2 versus 2.5 per million hours flown). Correspondingly, there were fewer fatalities in charter helicopter accidents (five) than in charter aeroplane accidents (13). There were no charter balloon accidents over this period, although there was a fatal charter balloon accident in 2013.

In 2012, charter hours flown by aeroplanes (about 402,000) were about four times higher than helicopter charter hours (about 95,000). There were about 7,000 charter hours flown by balloons.

Aerial work

Aeroplanes involved in all types of aerial work had only a slightly lower accident rate than for helicopters conducting aerial work (about 67 versus 77 per million hours flown over the 2004 to 2012 period). There are, however, significant differences in the types of aerial work that are performed by aeroplanes as opposed to helicopters. Unfortunately, the Bureau of Infrastructure, Transport and Regional Economics (BITRE) does not collect flying activity data for many sub-categories of aerial work (such as survey and photography, emergency medical services, fire control and mustering) to allow a comparison of these types.

The fatal accident rate in aerial work for helicopters over this period (about 11 per million hours flown) was slightly higher than the aeroplane fatal accident rate (about eight per million hours flown), but there were a greater number of fatalities involving helicopters (30 versus 23).

The amount of aerial work conducting in helicopters and aeroplanes is about equal. In 2012, there were about 217,000 hours flown by helicopters conducting aerial work, compared to about 253,000 for aeroplanes. In aerial agriculture (the only sub-category of aerial work for which flying activity is available from the BITRE), about seven times as many hours were flown by aeroplanes in 2012 (76,000) than by helicopters (13,000).

Flying training

Helicopters used for flying training were involved in a lot more accidents than fixed-wing aeroplanes. The helicopter accident rate from 2004 to 2012 was 93 per million hours flown, which was more than double that for aeroplanes conducting flying training (about 35 accidents per million hours flown). Most flying training is done in aeroplanes. In 2012, about 329,000 hours of fixed-wing flying training were recorded by the BITRE (compared to about 37,000 for helicopters). A large fall in fixed-wing flying training in Australia has occurred in recent years, with 30 per cent fewer hours flown in 2012 compared to a peak of 457,000 hours flown in 2009 (the highest of any year since 1990).

The fatal accident rate over the 2004 to 2012 period for helicopter flying training (about nine per million hours flown) was notably higher than that for aeroplanes (about one fatal accident per million hours flown), although there were fewer fatalities in total involving helicopters.

Private/business

Helicopters performing private or business flying had an accident rate over the 2004 to 2012 period that was about 60 per cent higher than that for aeroplanes (about 216 accidents per million hours for helicopters, compared to 133 per million hours flown for aeroplanes). Balloons being used for private/business flying had the highest accident rate over this period (1,096 per million hours flown), due to 16 accidents and a relatively small amount of flying activity. There were 1,599 hours flown in balloons used for other than charter in 2012, compared to 60,000 for helicopters and 304,000 for aeroplanes.

Helicopters also had a higher fatal accident rate, with about 75 per cent more fatal accidents involving helicopters than aeroplanes when corrected for flying activity (37 versus 21 fatal accidents per million hours flown). Due to the higher use of aeroplanes for private/business flying over this compared to helicopters, there were significantly more fatalities in those fatal accidents involving aeroplanes than in helicopter accidents. There were no fatal balloon accidents over this period.

Total power loss involving a Piper PA-28-161 Warrior (VH-CCQ), near Cunnamulla, Queensland (ATSB investigation AO-2013-168)

Recreational aviation

Data on recreational flying activity is collected by the BITRE from individual RAAOs and was available for the 2004 to 2011 period. Gyrocopters had a lower accident rate than other types of recreational aircraft over this period. The overall accident rate for gyrocopters was comparable with the accident rate for helicopters used for flying training.

Conversely, the fatal accident rate for gyrocopters over this period (47 per million hours flown) was almost double that of other recreational aircraft (29 per million hours flown for recreational aeroplanes, and 19 per million hours flown for weight shift aircraft). The fatal accident rate for gyrocopters was significantly higher than for all other aircraft and operation type combinations in air transport and general aviation.

The fatal accident rate for recreational aeroplanes was slightly higher than for private/business aeroplanes (29 versus 21 fatal accidents per million hours flown), as was the overall accident rate (about 182 versus 133 accidents per million hours flown).

Weight shift aircraft had a low accident rate compared to most other aircraft/operation types (48 per million hours flown), with only flying training helicopters, charter aeroplanes and charter helicopters being lower. The weight shift fatal accident rate was average when compared to all other aircraft/operation types

Occurrence types: what happened

Accidents and incidents are often the result of a complex set of circumstances, involving a chain (or sequence) of events. The ATSB categorises each reported accident, serious incident and incident into one or more occurrence types to identify what happened, and how the sequence of events played out to lead to an accident or incident. Classifying occurrences in this way helps to understand what types of occurrences have taken place, and identify potential areas for safety improvement and communication.

Occurrence types do not explain why an accident or incident happened, but generally are a description of what occurred. This report does not delve into the safety factors (individual actions, local conditions, risk controls, or organisational influences) that explain what led to an occurrence. An analysis of safety factors is more valuable when considering a cluster of occurrences that have a similar occurrence type (such as in the ATSB's *Avoidable Accidents* series), or through detailed ATSB investigations of particular accidents or serious incidents.

There are broad occurrence type categories used by the ATSB to classify occurrences. These changed in late-2013, and are currently:

- airspace-related
- infrastructure -related
- environment-related
- operational-related
- technical-related.

Consequential events that happen as the result of an occurrence (for example, forced and precautionary landings, emergency descents, rejected take-offs, evacuations and fuel dumps to reduce landing weight) are also recorded.

The five categories of occurrences are further broken down into different occurrence types, which are detailed in Appendix B. The ATSB records one or more occurrence types for all aircraft involved in each occurrence. Accidents and serious incidents generally have more occurrence types coded than incidents, as they are more likely to be investigated, and their severity usually means that there is a greater amount of information to draw upon for analysis and coding. In occurrences involving multiple aircraft, aircraft with the same operation type are recorded twice, whereas aircraft with different operation types are recorded against the corresponding operation type.

The frequency of a particular occurrence type does not necessarily reflect its importance or safety risk. For example, fuel-related events may be relatively rare (when compared with fumes events), but fuel starvation is always a very serious incident. Many fuel starvation events result in an attempt at an emergency landing, and potential aircraft damage and injury to people on board or outside the aircraft. In comparison, most fumes-related events are minor in nature, do not affect the safety of flight, and do not result in any injury.

Commercial air transport

Accidents and serious incidents

In 2013, most accidents and serious incidents in air transport operations were related to aircraft separation, aircraft control, powerplant and propulsion, fuel related, terrain collisions and runway events (Table 29).

Table 29: Accidents and serious incidents in air transport operations, by occurrence type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Airspace											
Aircraft separation	11	6	4	16	8	6	13	6	14	14	98
Operational non-compliance	2	3	0	5	4	3	2	1	0	3	23
ANSP operational error	1	2	1	2	1	0	0	2	1	2	12
Airspace infringement	0	0	0	1	1	1	0	0	0	0	3
Breakdown of co-ordination	0	0	0	0	0	0	1	0	0	0	1
Other	0	0	0	1	0	0	0	0	0	0	1
Environment											
Weather	3	1	0	4	4	1	6	0	7	6	32
Wildlife	1	0	0	2	0	0	1	0	1	1	6
Interference with aircraft from ground	0	0	0	0	0	0	0	0	0	1	1
Infrastructure											
Other	1	1	0	0	0	0	0	0	0	0	2
Operational											
Aircraft control	7	6	6	15	19	11	14	6	13	9	106
Crew and cabin safety	5	9	4	11	17	9	5	6	4	4	74
Terrain Collisions	4	7	5	9	12	3	8	11	7	6	72
Runway events	1	2	5	8	8	1	5	7	5	10	52
Fuel related	5	2	0	4	6	3	1	2	2	7	32
Communications	3	1	2	2	4	1	3	3	3	2	24
Fumes, smoke, fire	4	4	1	1	6	3	2	1	0	2	24
Flight preparation / navigation	1	4	0	4	0	1	4	0	2	2	18
Ground operations	2	0	1	1	1	1	1	4	3	4	18
Miscellaneous	0	0	2	0	6	3	4	0	1	1	17
Ground proximity alerts / warnings	1	1	0	2	0	1	0	0	2	1	8
Aircraft loading	1	0	0	0	0	0	1	0	0	0	2
Technical											
Powerplant / propulsion	7	5	5	9	17	6	10	12	7	10	88
Systems	4	5	2	6	9	5	2	4	2	3	42
Airframe	5	4	1	4	3	3	5	5	4	2	36
Consequential events	14	16	12	19	30	16	20	16	12	19	174

Aircraft separation

There were 14 serious incidents in 2013 where an air transport aircraft was involved in a separation or aircraft proximity issue. Aircraft separation issues were the second most common type of serious incident in commercial air transport over the last 10 years.

By their nature, these types of serious incidents indicate a reduced safety margin between two aircraft, and an increased risk of a mid-air collision.

They included a conflict between a Bombardier DHC-8 and an ATR 72 near Port Macquarie in low visibility conditions (see page 17), a near-miss between a Piper PA-31 and a Cessna near a visual flight rules (VFR) reporting point (page 52). In one serious incident, a lapse by an air traffic controller at Moorabbin Airport allowed an aircraft to be cleared for take-off while a helicopter was occupying the runway (page 56).

In October 2013, the ATSB published a research investigation that reviewed all loss of separation occurrences since 2008 (ATSB investigation AR-2012-034).

There were several serious incidents where two aircraft came too close in uncontrolled airspace, particularly in the vicinity of non-controlled aerodromes. These often occurred due to a reliance on un-alerted see-and-avoid principles to maintain aircraft proximity, because one or both of the pilots did not hear broadcasts made by the other on the Common Traffic Advisory Frequency (CTAF). This limited both pilot's situational awareness of each aircraft's position and of the other pilot's intentions. Examples were a Bombardier DHC-8 flight crew who did not hear the taxiing broadcast of a Bell 412 crew, resulting in the helicopter passing in close proximity to the DHC-8 on final approach (page 18). In another incident, the pilot of a de Havilland DH.82 Tiger Moth was on the take-off roll when the pilot observed a Piper PA-34 commencing take-off on the same runway. The Tiger Moth pilot rejected the take-off to avoid a collision (ATSB occurrence 201308266).

Runway events

There were 10 runway events in 2013 involving air transport aircraft that were serious incidents, as well as one accident. This was the highest number in the last 10 years.

Several of these serious incidents were also aircraft separation events and runway incursions, involving two aircraft attempting to take off from the same runway at the same time, or one aircraft taking off over the top of another aircraft. There were three runway excursions where the aircraft veered-off the side of the runway, due to either crosswinds or a landing gear mechanical failure. In once serious incident, a Fokker 100 attempted to take off at night when aligned with the runway edge lights (page 30).

ATSB investigation AO-2013-036

When 19 NM and 10 NM from Corowa, NSW, the pilot of the Cessna 310 reported broadcasting an inbound call on the Corowa CTAF. The pilot broadcast additional calls on the CTAF advising he was on base and final for runway 23. However, runway 05/23 was being closed for works. Workers at Corowa Airport were in the process of placing the last unserviceability cross marker near the runway 05 threshold when they observed the aircraft on final approach. The workers' vehicle was also positioned on the runway. The workers and vehicle vacated the runway. Immediately after landing, when about 90 to 120 m along the runway, the pilot observed an unserviceability cross marker on the ground. The workers were monitoring the CTAF on a hand held radio, but no broadcasts from the pilot were reportedly heard.

Powerplant / propulsion

Four accidents and six serious incidents relating to engine malfunctions on air transport aircraft were reported to the ATSB in 2013. In most cases, a power loss occurred during climb or cruise, and the pilot had time to make a diversion or a successful forced landing.

Several of these occurrences were catastrophic engine failures:

- During a charter flight, the Beech Baron's left hand engine failed resulting in serious internal damage to the engine and the cowling. The pilot declared a MAYDAY and diverted to Toowoomba. A post-flight inspection revealed the engine failure was uncontained, with one cylinder detaching from the engine block and protruding through the cowling (ATSB occurrence 201307174).

- A Beech King Air was conducting a charter flight from Utirik Atoll to Majuro Atoll in the Marshall Islands. Approximately 40 minutes into the flight, the crew observed abnormal engine oil pressure indications. Two minutes later, the left engine failed. The flight crew secured the engine and elected to continue to Majuro Atoll where a single engine landing was conducted without further incident. The engine failure was contained and there were no injuries. The left engine was disassembled, exhibiting significant damage to the first stage reduction gears and evidence of electrical discharge damage on the gear teeth. All of the second stage power turbine blades had separated from the disc as a result of overstress (ATSB investigation AO-2013-154).

In one occurrence, the pilot was able to restart the engine and use partial power to make a diversion. In this serious incident, the aircraft's right magneto had failed and the tachometer points had earthed out (ATSB occurrence 201301167). In another occurrence, a helicopter pilot's attentiveness to abnormal engine indications ensured that there was time to make a precautionary landing before the engine failed. On descent, the pilot lowered the collective and heard an intermittent noise. The pilot checked the gauges, with nothing unusual noted. The noise continued to develop and the pilot elected to land. As the helicopter descended through 400 ft above ground level (AGL), the engine-transmission drive shaft failed. The pilot initiated an autorotation. During the touchdown, the main rotor blade severed the tail boom. The helicopter sustained substantial damage, but none of the occupants were injured (ATSB investigation AO-2013-208).

Aircraft control

Six accidents and three serious incidents relating to aircraft control issues in air transport aircraft were reported to the ATSB in 2013. One of these was a fatal accident, involving the in-flight break-up of a de Havilland Tiger Moth while on a joy flight around the Gold Coast area (see page 27).

Many of these accidents were due to wheels-up landings, where the pilot was distracted from deploying the landing gear on approach due to weather, cockpit conversation (see page 29), or arrival pressures.

ATSB investigation AO-2013-039

A Cessna 210M was returning to Broome Airport, WA via a position north of the airport to land on runway 10. The conditions on the day were windy and wet with thunderstorms and rain moving through the area, requiring the pilot to alter the aircraft's flight plan and flight path to divert around the weather. The pilot reported selecting the landing gear down as part of his landing checks, and a passenger later reported that he heard what he believed to be the landing gear being lowered. The pilot was advised of an 18 kt crosswind when cleared to land. Shortly before landing the pilot completed his final checks, but did not look out the window to visually check that the landing gear was down. To compensate for the crosswind, the pilot operated the aircraft at a slightly higher throttle setting, until flaring to land. The Cessna landed on the runway with the landing gear retracted and skidded about 300 to 350 m down the runway on the underbelly. The controller activated the airfield emergency response.

Collapsed landing gear involving a Cessna 210 Centurion (VH-PBV), at Broome Airport, Western Australia (ATSB investigation AO-2013-039)

Fuel related

One accident and six serious incidents relating to fuel were reported in 2013 and involved an air transport aircraft.

Three of these serious incidents involved operations in weather conditions that were not forecast, or where a change in weather conditions en route was not considered (see page 21). This included the serious incident involving a Virgin Australia Boeing 737 en route from Brisbane to Adelaide, which was required to divert on arrival at Adelaide due to un-forecast weather. When the crew diverted to Mildura, the crew discovered that the weather was also not as reported. Without enough fuel remaining to divert again, the flight crew was left with no choice but to make a landing below minima at Mildura (see page 19).

Other serious incidents occurred due to fuel exhaustion, use of the incorrect fuel type, blocked fuel filters leading to an engine failure, and fuel imbalance resulting in aircraft control problems.

One example was a Fairchild SA227 Metro which landed at Brisbane Airport with a suspected fuel indication problem. The pilot checked the fuel quantity after landing and advised engineering staff that the fuel tanks were out of balance and the left fuel quantity gauge was unserviceable. The unserviceability was recorded on the aircraft maintenance log. The pilot and engineers rebalanced the fuel tanks, and refuelled the aircraft for the subsequent flight to Bankstown, NSW. The pilot then concluded his duty for the day. The pilot of the next flight was en route to Brisbane Airport when he contacted operations staff requesting an additional 200 L of fuel be uploaded due to bad weather forecast at Bankstown. Unaware that the previous pilot and engineers had corrected the imbalance, a staff member ordered the additional fuel as requested by the pilot. He requested that 150 L be put in the left tank and 50 L in the right to balance the fuel tanks. The extra 100 L of fuel was subsequently loaded into the incorrect tank, resulting in an estimated 200 L imbalance. When the pilot arrived at Brisbane, he assessed that the previous pilot and engineers had established the fuel quantity, which complied with the minimum equipment list requirements. The pilot opened the cross-flow valve, and the serviceable fuel gauge dropped and then stabilised. He believed that he had removed the fuel imbalance and that the aircraft was now in balance. In the early hours of the morning, the pilot took off from Brisbane. During the initial climb, the pilot reported that the right wing dropped markedly but he was able to maintain control of the aircraft. The pilot raised the right wing and opened the fuel cross-flow valve to rebalance the aircraft. After about 2 minutes, the pilot reported that the aircraft was in trim and he closed the cross-flow valve. During the approach to Bankstown, the aircraft handled normally until at about 400 ft AGL, when the right wing dropped again as the final stage of flap was selected. The pilot raised the right wing and

elected to continue the approach, landing without further incident (ATSB investigation AO-2013-196).

Incidents

The most common incident types in 2013 involving air transport operations were wildlife strikes, aircraft system problems, and weather-related issues (Table 30).

Table 30: Incidents in air transport operations, by occurrence type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Airspace											
Aircraft separation	235	231	145	119	181	160	154	184	207	234	1,850
ANSP operational error	156	237	244	183	162	121	74	47	57	91	1,372
Operational non-compliance	48	74	59	95	108	72	96	82	110	118	862
Airspace infringement	14	11	14	26	24	15	10	11	19	14	158
Breakdown of co-ordination	12	21	10	25	25	19	15	4	11	15	157
Other	8	14	13	3	6	4	1	1	5	5	60
Environment											
Wildlife	853	953	924	957	1,055	1,162	1,337	1,409	1,311	1,386	11,347
Weather	156	155	126	147	174	140	209	249	301	458	2,115
Interference with aircraft from ground	1	1	4	5	1	3	4	6	8	9	42
Infrastructure											
Runway lighting	15	12	13	12	15	24	15	12	19	12	149
Other	12	14	13	16	11	8	6	4	7	11	102
ATM	10	29	6	4	5	1	5	0	1	1	62
Navaids	8	10	8	2	3	4	7	5	2	2	51
Radar / surveillance	1	0	0	0	2	2	6	3	7	2	23
Operational											
Miscellaneous	91	138	215	234	323	292	265	277	387	266	2,488
Fumes, smoke, fire	72	103	101	123	143	135	261	285	305	281	1,809
Aircraft loading	36	42	78	115	91	65	124	221	222	202	1,196
Aircraft control	57	70	91	81	97	80	96	136	203	219	1,130
Communications	141	125	114	85	138	95	67	73	76	90	1,004
Ground proximity alerts / warnings	163	242	149	83	37	22	18	38	69	171	992
Crew and cabin safety	56	69	52	96	73	66	83	120	87	148	850
Ground operations	48	45	56	66	66	49	49	76	72	58	585
Flight preparation / navigation	66	78	65	79	58	29	40	50	52	46	563
Runway events	46	34	39	41	53	41	47	59	61	58	479
Fuel related	31	23	33	54	52	35	30	35	32	35	360
Terrain collisions	10	12	12	13	15	10	8	8	5	13	106
Technical											
Systems	265	298	281	319	354	299	413	476	497	479	3,681
Airframe	149	204	154	180	235	209	244	293	252	254	2,174
Powerplant / propulsion	156	165	165	202	196	200	170	210	236	188	1,888
Consequential events	397	433	596	589	675	668	624	710	820	776	6,288

Wildlife strikes

Most wildlife strikes involving air transport aircraft were birdstrikes, with a small number of animal strikes reported. The number of birdstrikes has doubled over the last decade, driven by the large increase in aircraft movements (departures and landings) in high capacity regular public transport (RPT) operations over the same period. In recent years, the ATSB, airport and airline operators have worked together to improve reporting processes for confirmed and suspected birdstrikes. This has resulted in a modest increase in the rate of birdstrikes per aircraft movement.

There were 11 bird and bat species that accounted for more than 20 strikes each:

- Black kite (54 strikes)
- Galah (50 strikes)
- Bat (45 strikes)
- Plover (42 strikes)
- Kite (33 strikes)
- Flying fox (32 strikes)
- Swallow (26 strikes)
- Nankeen kestrel (26 strikes)
- Magpie (20 strikes)
- Duck (20 strikes)

There were 594 wildlife strikes reported to the ATSB in 2013 involving air transport aircraft where the species was not known. This represents slightly under half of all wildlife strikes.

Aircraft system issues

Over one-third of aircraft system issues were avionics or flight instrument problems. The majority of these incidents were minor in nature, and affected a wide range of aircraft systems and aircraft types. One exception was an aircraft systems failure that resulted in smoke in the cockpit on a Bombardier DHC-8 flight from Sydney to Wagga Wagga, NSW. The flight crew advised ATC of the smoke issue, and elected to divert to Canberra. The aircraft was disembarked as a precaution. This incident is currently being investigated by the ATSB (ATSB investigation AO-2013-120).

About 15 per cent were air and pressurisation system issues, mostly relating to abnormal temperature or pressurisation indications on the ground or during climb. A similar proportion were electrical issues, particularly generator failures and generator control units (GCUs), flight control problems, and hydraulic issues.

Very few incidents (less than five per cent of all systems issues) related to anti-ice protection, data link failures in remotely piloted aircraft, or fuel system problems.

Weather

The ATSB received over 450 reports of weather-related incidents that affected safe air transport operations in 2013. Often, different types of weather events are associated with each other; so many occurrences had more than one weather event recorded. About half of weather-related incidents involved windshear or turbulence (310 incidents), with lightning strikes the next most commonly reported incident (119 incidents). There were also eight incidents involving an aircraft operation being affected by un-forecast weather. Very few icing incidents were reported.

Windshear resulting in overbank was most common, as was moderate (75 incidents) and severe turbulence (62 incidents). The remaining turbulence/windshear/microburst occurrences usually resulted in overshoot, overspeed, or sink. Clear air (72 incidents) and wake (40 incidents) turbulence were the most common types.

Most reported lightning strikes resulted in no reported damage or injury, and in only about 10 per cent (16 incidents) did the strike result in an operational deviation, such as a diversion or a

precautionary descent. In only nine incidents was evidence of the lightning strike detected. There was only one incident where a minor injury occurred as a result of a strike.

ATSB occurrence 201311109

During cruise near Scone, NSW, the Fairchild Metro was struck by lightning resulting in a temporary avionics failure. The pilot received a minor shock through the throttle quadrant.

Un-forecast weather incidents were infrequent and tended to involve fog at the destination, or severe turbulence during descent. In these incidents, extended holding or a diversion were normally conducted. Icing occurrences tended to temporarily affect the aircraft's trim or pitot-static systems with little to no impact on the flight.

General aviation

Accidents and serious incidents

In 2013, most accidents and serious incidents involving GA aircraft were associated with terrain collisions, aircraft separation, aircraft control, and powerplant and propulsion problems (Table 31).

Table 31: Accidents and serious incidents in GA operations, by occurrence type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Airspace											
Aircraft separation	24	15	21	22	36	28	34	42	58	68	348
Operational non-compliance	5	5	6	5	13	8	3	7	11	7	70
ANSP operational error	1	1	2	0	4	3	1	2	1	1	16
Airspace infringement	0	1	1	1	2	3	1	1	0	2	12
Other	0	0	0	0	0	0	0	0	0	1	1
Environment											
Weather	4	2	4	13	3	12	9	4	8	7	66
Wildlife	2	5	0	2	2	3	3	4	1	4	26
Interference with aircraft from ground	0	0	0	0	1	0	0	0	0	0	1
Infrastructure											
Other	0	0	1	0	0	1	0	0	0	0	2
Runway lighting	0	0	0	0	0	0	0	0	1	0	1
Operational											
Terrain collisions	90	93	75	98	117	85	138	105	103	92	996
Aircraft control	48	44	35	44	51	44	38	47	49	58	458
Runway events	15	9	10	21	20	22	21	18	20	21	177
Fuel related	4	7	4	6	9	8	14	16	16	7	91
Communications	8	2	2	1	10	4	6	11	15	18	77
Fumes, smoke, fire	4	3	4	4	6	6	4	2	4	2	39
Flight preparation / navigation	4	2	2	4	4	6	0	4	6	5	37
Crew and cabin safety	3	3	3	3	5	3	2	5	3	2	32
Ground operations	4	2	0	5	1	5	2	4	3	3	29
Miscellaneous	2	2	1	0	2	1	5	2	3	4	22
Aircraft loading	0	0	0	1	1	1	0	0	0	0	3
Technical											
Powerplant / propulsion	45	27	37	64	40	50	42	36	40	33	414
Airframe	8	6	4	3	4	9	10	7	7	17	75
Systems	3	4	2	3	5	6	10	9	1	5	48
Consequential events	61	46	42	61	49	61	72	55	66	61	574

Terrain collisions

About half of the terrain collisions in 2013 that involved a GA aircraft were collisions with terrain (38 accidents and six serious incidents). As has been the case in previous years, most other terrain collisions in 2013 were wirestrikes, with a small number of ground strikes also reported to the ATSB.

Collision with terrain accidents were associated with a number of precursor events, especially engine failures in single-engine aircraft. While some of these were associated with forced landings

after the power loss, those accidents that resulted in fatalities and serious injuries tended to be those where the pilot continued a flight after a partial power loss, either by conducting a circuit or attempting a turnback. Most collision with terrain accidents and serious incidents were investigated by the ATSB, and these investigations are discussed earlier in this report in *General aviation* from page 32 onwards.

General aviation aircraft striking a wire resulted in five accidents and 24 serious incidents in 2013. None resulted in a fatal or serious injury accident. Each of the accidents generally involved a resulting collision with terrain, and was investigated by the ATSB. Serious incidents involved wirestrikes where the aircraft was able to fly away, or make a precautionary landing. All but one of these accidents and serious incidents involved an aerial work aircraft, almost all of which were engaged in aerial agriculture. It was generally not known whether the aircraft was fitted with wire protection devices, or whether the pilot was aware of the wire prior to contacting it.

There was an increase in ground strike accidents and serious incidents involving GA aircraft in 2013 when compared to 2012. Where the type of GA flying was known, almost all involved aerial agriculture, private or business aircraft. None resulted in serious or fatal injuries, although most resulted in serious aircraft damage.

Collision with terrain involving a Robinson R44 helicopter (VH-HWQ), at Bulli Tops, New South Wales (ATSB investigation AO-2013-055)

Aircraft separation

In 2013, 122 GA aircraft were involved in 68 aircraft separation accidents and serious incidents. This included three mid-air collisions, one of which was fatal.

Fifty-eight of these serious incidents were near collisions that happened in the circuit, approach, or initial climb when aircraft have a greater potential to get too close. Fourteen were investigated by the ATSB in 2013. Most near collisions involved flying training, private, or business aircraft.

ATSB investigation AO-2013-019

When at the '2RN' VFR approach point near Bankstown Airport, the pilot of a Piper PA-44 attempted to broadcast an inbound call to Bankstown Tower. He tried on two occasions, however, reported that the call was over-transmitted. The pilot determined that communications with Bankstown Tower could not be established and the aircraft subsequently entered the Bankstown control zone (CTR) without a clearance. Soon after, the pilot and passenger of a Beech Bonanza observed an unidentified aircraft in their 2 o'clock position at about the same altitude. Shortly after, air traffic control advised the Beech pilot that there was an unidentified aircraft to the south, about 0.5 NM away. The pilot replied that he would descend and monitor the aircraft. The pilot reported descending 50 to 100 ft and conducting a slight right turn. As the Piper passed overhead the Beech, vertical separation reduced to 200 ft and then increased to 400 ft as the Beech descended.

The Civil Aviation Safety Authority VFR flight guide recommends that pilots should consider initiating radio contact with air traffic control far enough away from the CTR boundary to preclude entering Class D airspace before two-way communications are established. This is particularly important when operating into busy airports such as Bankstown.

The majority of near collisions occurred between aircraft on crossing or converging tracks.

Aircraft control

Forty-five aircraft control accidents and 10 serious incidents involving aircraft control problems were reported to the ATSB in 2013 involving GA aircraft. The most common reasons were a loss of control and hard landings, most of which were investigated by the ATSB. There was also an in-flight break-up involving a PZL Dromader involved in aerial fire control operations, which is currently under investigation (see page 50). Other less common aircraft control accidents and serious incidents in GA involved wheels-up landings, aircraft configuration, and control issues.

Loss of control accidents involved all types of GA operations and were evenly split between operations in the air and operations on the ground (during taxi, take-off, or landing). Many were associated with a bouncy landing (due to a hard landing or a gust) that resulted in a loss of directional control and/or damage to the landing gear, and sometimes a runway excursion. Those loss of control accidents involving helicopters were more likely to result in substantial aircraft damage and occupant injury that those involving aeroplanes. Seventeen of the 25 loss of control accidents and serious incidents reported in 2013 were investigated by the ATSB, and many of these investigations are summarised earlier in this report.

Eight hard landing accidents in 2013 were investigated by the ATSB, including an accident that resulted in serious injuries. About half involved helicopters, a greater proportion than in 2012. Private and business aircraft were most likely to be involved in hard landing accidents.

Powerplant and propulsion

The majority of engine-related accidents and serious incidents involving GA aircraft that were reported to the ATSB in 2013 were due to an engine failure or malfunction (33). Some occurrences were due to propeller issues or abnormal engine indications, and were followed by a forced landing. Fourteen GA engine failures/malfunctions in 2013 were investigated by the ATSB. In those accidents and serious incidents where the cause was identified, fuel exhaustion, fuel

contamination, loose exhaust slip joints, cracked cylinder heads, cracked governor top covers, faulty magnetos, conrod failure, and blocked fuel injectors all contributed to engine failures.

About half of the engine failures occurred shortly after take-off and during climb. In many of these cases, the pilot conducted a forced landing on the remaining runway or in a paddock. In most of these occurrences, the aircraft was damaged but the occupants were not injured. There was one fatal accident in 2013 involving an engine failure in a GA aircraft (Rand Robinson KR-2, discussed further on page 65), and two serious injury accidents.

Collision with terrain involving a Glasair III (VH-USW), near Jandakot, Western Australia (ATSB investigation AO-2013-221)

ATSB investigation AO-2013-221

An amateur-built Glasair III took off from runway 24R at Jandakot Airport, WA with a pilot and passenger on board. Shortly after take-off, the pilot broadcast on the Jandakot Tower radio frequency that they had had an engine failure. There were no further transmissions from the aircraft.

The aircraft was seen flying at a low altitude in a northerly direction over South Lake, a residential area about 3 km south-west of the airport. Witnesses in the vicinity of a sports field at South Lake heard the sound of an impact and saw a fireball and the burning aircraft tumbling along the ground at the field before coming to rest. A number of people rushed to assist and found the two occupants clear of the burning wreckage. First aid was administered until emergency services arrived. The pilot and passenger sustained serious burns and were taken to hospital. The aircraft was destroyed by impact forces and an intense post-impact fuel-fed fire.

The pilot was reported to have flown beneath a nearby set of power transmission lines before the aircraft clipped trees that bordered the southern end of the sports field and then struck a metal goal post at that end of the field. The ATSB examined the wreckage and found that the aircraft's left wing was sheared off by the collision with the goal post, just outboard of the fuselage. This liberated fuel from the ruptured wing fuel tank. Images from a nearby surveillance camera captured the latter part of the impact sequence and showed that the fuel ignited almost immediately after the wing collided with the goal post.

The aircraft structure, which is constructed primarily of fibreglass/resin and carbon fibre, was almost completely burnt. The aircraft's instruments and controls were almost completely destroyed by fire. The fully bent-back propeller blades and propeller strike marks on the ground were consistent with a 'wind milling' propeller.

The ATSB investigation is currently underway.

Incidents

The most common types of incidents involving GA aircraft in 2012 were wildlife strikes, runway events, and aircraft separation issues (Table 32).

Table 32: Incidents in GA operations, by occurrence type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Airspace											
Aircraft separation	124	128	136	136	181	185	153	200	192	195	1,630
Operational non-compliance	38	67	100	130	269	218	198	194	166	127	1,507
ANSP operational error	48	57	79	64	71	53	29	22	34	57	514
Airspace infringement	26	26	71	69	59	50	39	40	42	38	460
Breakdown of co-ordination	5	2	3	10	8	5	9	2	11	15	70
Other	6	11	3	1	1	1	1	1	2	6	33
Environment											
Wildlife	297	389	387	382	361	406	409	364	335	338	3,668
Weather	9	12	11	26	18	9	19	23	18	21	166
Interference with aircraft from ground	0	1	3	2	3	0	3	1	5	2	20
Infrastructure											
Runway lighting	2	6	8	4	5	2	9	1	5	4	46
Other	1	5	4	4	2	2	2	4	5	2	31
ATM	1	3	8	0	2	1	0	0	0	2	17
Radar / surveillance	0	0	0	0	1	0	2	1	1	0	5
Navaids	1	0	0	0	0	1	0	1	0	0	3
Operational											
Runway events	165	232	264	229	298	455	302	267	245	248	2,705
Communications	91	77	176	125	202	150	139	120	123	132	1,335
Flight preparation / navigation	71	109	122	123	74	76	66	55	48	63	807
Aircraft control	49	67	51	68	53	57	40	52	65	56	558
Terrain collisions	42	46	29	44	43	51	33	34	36	46	404
Fumes, smoke, fire	39	30	38	40	36	32	41	42	31	36	365
Miscellaneous	28	26	27	26	39	37	40	42	40	33	338
Ground operations	26	37	28	30	26	31	32	22	26	28	286
Fuel related	16	21	13	18	19	13	21	20	14	12	167
Crew and cabin safety	9	10	7	8	2	7	8	6	9	6	72
Aircraft loading	1	2	1	4	4	1	3	1	2	1	20
Ground proximity alerts / warnings	1	4	0	0	0	1	2	1	0	1	10
Technical											
Systems	185	176	147	136	126	134	176	166	168	143	1,557
Powerplant / propulsion	140	148	126	166	167	148	117	144	151	125	1,432
Airframe	98	91	134	121	126	140	131	157	158	134	1,290
Consequential events	226	258	344	309	335	343	303	328	354	325	3,125

Wildlife

Almost all wildlife strikes involving GA aircraft in 2013 were birdstrikes (325 of 338 incidents), with only 12 animal strikes reported. Compared to wildlife strike reporting by air transport operators and

aerodrome operators (which has doubled over the last 10 years), the number of birdstrikes involving GA aircraft reported to the ATSB has been relatively unchanged over this time.

Most birdstrikes occurred within the aerodrome confines (296incidents), with only one bird struck (284 incidents). Medium-sized birds were most commonly struck (163 incidents), followed by small birds (88 incidents) – in only 18 incidents was a report made where a GA aircraft struck a large bird. Where damage was reported from the birdstrike (in about 10 per cent of strikes), the wing or rotor was the most likely part of the aircraft to be involved (29 occurrences).

Only about a quarter of birdstrike reports in 2013 involving GA aircraft identified the type of bird. Galah, Black kite, Magpie, Plover, Kite and Bat were the only species where more than 10 strikes were recorded. Animal strikes generally involved small animals (such as hares, rabbits and snakes), with medium to large animal strikes (wallabies and kangaroos) involved in only six incidents.

Runway events

Runway events involving GA aircraft in 2013 were most often runway incursions (169 of 248 incidents), almost all involving an incursion by an aircraft due to the pilot's actions. While most runway incursions (78 per cent) did not affect other aircraft, in about 15 per cent of incidents, a go-around was conducted as a result of the incursion. Most incursions were low risk – 54 per cent were rated as ICAO severity index 'D' and only four incursion incidents were rated as higher risk (ICAO serverity index 'A' or 'B').

Aircraft using an incorrect runway accounted for the second largest share of runway events reported to the ATSB in 2013 (39 incidents). Aircraft approaching or landing on the wrong runway were most common. Runway veer-offs in dry conditions accounted for most of the remaining runway events involving GA aircraft.

Aircraft separation

Most aircraft separation incidents involving GA aircraft in happened in the circuit area. This included aircraft turning base inside another aircraft turning base, aircraft following the incorrect aircraft, pilots not being heard to make broadcasts on the CTAF, and aircraft approaching the same or reciprocal runways at the same time and converging. Other separation issues involved a conflict between an aircraft entering the runway, and another aircraft occupying or on approach to the same runway. They often occurred at aerodromes outside of controlled airspace, where ATC does not provide separation between aircraft, and where specific separation standards do not exist. As a result, it is difficult for the ATSB to determine the proximity of the aircraft involved in many of these incidents. These accounted for the largest proportion of GA aircraft separation incidents reported in 2013 (94 of the 195 incidents). In the majority of these cases, the conflicting aircraft were visually separated, and about half of the time one or both of the pilots manoeuvred their aircraft to reduce the risk of a collision.

ATSB occurrence 201303746

A Robinson R22 helicopter departed from Cloncurry, Qld tracking to the north. At the same time, a Bombardier DHC-8 aircraft conducting a scheduled service from Townsville was on approach to runway 30 at Cloncurry. The helicopter departed across the runway at about 100 ft as the Bombardier landed. The helicopter pilot realised he had been broadcasting on the ultra-high frequency (UHF) radio, although he could hear calls on the very high frequency (VHF) CTAF.

ATSB occurrence 201304584

The pilot of a Bell 206 helicopter was conducting a private flight from Mangalore to Echuca, Vic., and tracking via the Nagambie township at 1,000 ft to avoid the R351 restricted area. After passing in the vicinity of Nagambie Lakes, the pilot received a call on the CTAF from a drop zone safety officer on the ground at Nagambie advising that he had just flown over a parachuting landing area. At that time, five parachutists had just landed and six were still airborne.

There were 59 loss of separation and 30 loss of separation assurance incidents reported in 2013 involving GA aircraft. Many of these were induced by non-compliance with ATC instructions (such as maintaining an altitude requirement) or with a published procedure, or by an airspace infringement. In some incidents, ATC provided a clearance to one aircraft before establishing a separation standard with another aircraft.

ATSB occurrence 201310862

A Diamond DA-40 was cleared to cross runway 29C at Bankstown Airport, and a Socata TBM 700 was cleared to land on runway 29R. The controller subsequently observed the Socata on short final for runway 29C and instructed the crew of the Diamond to immediately hold short of the runway surface and the Socata crew conducted a low level missed approach. This resulted in a loss of runway separation.

ATSB occurrence 201310899

The tower controller at Townsville Airport issued an unrestricted departure clearance to the crew of a Bell 412 helicopter after the crew had stated that they would depart to the south. The helicopter subsequently tracked north resulting in a loss of wake turbulence separation with a Boeing 737 that had just departed. The controller issued a wake turbulence caution before the Bell entered the wake turbulence envelope.

There were also 17 incidents involving a TCAS alert between two aircraft. Similarly to other types of aircraft separation issues, TCAS alerts generally occurred because the pilot of one aircraft had not been heard broadcasting on the CTAF, was broadcasting on an incorrect radio frequency, or the aircraft was not at its assigned or reported altitude or position.

Recreational aviation

Accidents and serious incidents

Accident and serious incident reporting in the recreational aviation community has improved in recent years, as shown by the difference in the number of occurrences reported to the ATSB in 2004 as compared to 2013 (Table 33). Significant growth in recreational flying has driven this increase, as has greater awareness among pilots and recreational aviation administration organisations (RAAOs) of the need to report accidents and serious incidents to the ATSB.

The most common types of accidents and serious incidents in recreational aviation are similar to those in general aviation. The most common in 2013 were terrain collisions, engine malfunctions, aircraft control problems and runway events.

Table 33: Accidents and serious incidents in recreational aviation, by occurrence type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Airspace											
Aircraft separation	0	1	2	3	6	2	3	1	4	4	26
Operational non-compliance	0	0	0	0	0	1	0	0	1	0	2
Airspace infringement	0	0	1	0	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	0	0	0	1	1
Environment											
Weather	0	0	0	0	1	1	4	0	7	4	17
Wildlife	0	0	0	0	1	0	1	0	0	2	4
Infrastructure	0	0	0	0	0	0	0	0	0	0	0
Operational											
Terrain collisions	8	7	7	25	28	35	35	44	50	56	295
Aircraft control	2	1	0	10	12	8	20	17	35	32	137
Runway events	0	0	0	2	6	6	4	10	11	15	54
Fuel related	0	0	0	1	4	1	0	1	6	7	20
Communications	0	1	0	1	3	2	0	1	1	1	10
Fumes, smoke, fire	0	0	0	1	1	1	3	0	0	1	7
Ground operations	0	0	0	2	0	1	1	0	2	0	6
Flight preparation / navigation	0	0	0	0	0	1	0	0	1	1	3
Miscellaneous	0	0	0	0	1	0	1	0	0	0	2
Technical											
Powerplant / propulsion	2	0	0	14	17	10	24	17	41	34	159
Airframe	0	0	0	0	3	2	4	1	10	4	24
Systems	0	0	0	0	2	2	0	0	4	4	12
Consequential events	1	0	0	11	22	9	27	18	39	34	163

Terrain collisions

There were 56 terrain collisions involving recreational aircraft that were reported to the ATSB in 2013, and were classified as an accident or a serious incident. Twelve involved fatal injuries and six involved serious injuries to the aircraft occupants. These are discussed in detail in the *Recreational* section of this report on page 74.

Very few recreational aviation accidents are investigated by the ATSB. In 2013, there were two accidents where the ATSB provided technical assistance to an RAAO accident investigation.

Most (47) terrain collision accidents were collisions with terrain, with eight ground strikes and three wirestrikes also reported. Many collisions with terrain involved a loss of directional control (due to a crosswind or a landing gear mechanical failure) during landing followed by a runway excursion. Runway overruns, and engine failures followed by a forced landing were also common. In 18 of the 47 collision with terrain accidents, there was no information reported to the ATSB about the circumstances of the collision, or why pilot could not control the aircraft. This included several fatal accidents.

ATSB occurrence 201306340

During the approach to land near Casino, NSW, the Skyfox CA25's engine failed and the pilot conducted a forced landing. The aircraft subsequently collided with an electrical fixture and came to rest inverted. An inspection found the carburettor bowls were fitted incorrectly which allowed air to enter the fuelling system and fuel to leak from the left carburettor.

ATSB occurrence 201308495

During the landing on a road near Coorabie, SA, the Foxbat did not slow as expected. The pilot attempted to take off again, which resulted in a tail strike and a collision with a fence. The aircraft was substantially damaged. The pilot reported that the wind had unexpectedly changed to a tail wind.

ATSB occurrence 201309076

During initial climb from The Oaks, NSW, the engine of the Jabiru LSA did not develop full power and subsequently failed during the circuit. The pilot attempted to land back on the runway but collided with trees resulting in substantial damage. The pilot received minor injuries and the passenger was seriously injured.

Four collisions with terrain reported to the ATSB in 2013 involved gyrocopters registered with the Australian Sport Rotorcraft Association (ASRA), and two involved weight shift aircraft registered with the Hang Gliding Federation of Australia (HGFA). The remainder involved recreational aeroplanes registered with Recreational Aviation Australia (RA-Aus). There was one accident involving a hang glider being towed where the registration was not reported.

Other types of terrain collisions reported to the ATSB that involved recreational aviation aircraft were wirestrikes and ground strikes. It was reported that the wirestrikes occurred when the pilots' attention was focused on another matter (turbulence, other power lines, deteriorating weather conditions). Most of the ground strikes were associated with hard landings, windshear, or control problems on approach.

Powerplant / propulsion

The 34 powerplant-related accidents and serious incidents reported to the ATSB in 2013 in this operation type included three that involved in serious injuries (as a result of a forced landing or collision with terrain after an engine failure or drive loss).

Of the 32 engine failure or malfunctions, the majority occurred while the aircraft was in cruise. As almost all powered recreational aircraft are single-engine, a forced landing is generally the only remaining option for the pilot. In ten of these occurrences, the pilot attempted or was able to make a forced landing on the remaining runway, or conduct a diversion to an aerodrome. In the remaining occurrences, an outfield forced landing was conducted (usually in a paddock, or on a

road or beach, but sometimes a ditching into water). In a few cases, the aircraft collided with terrain (such as trees) before the aircraft was able to land.

Where reported, reasons for engine malfunctions included fuel leaks or blocked fuel lines, fuel vapour lock, magneto failure, fractured cylinder bolts, failed hydraulic valve lifters, and a broken engine through-bolt. In many accidents of this type involving recreational aircraft, the reason for the power loss and engine failure was not reported to the ATSB.

The remaining powerplant and propulsion-related accidents and serious incidents in 2013 were propeller and transmission-related.

ATSB occurrence 201306820

The pilot and passenger of an ELA Tandem gyrocopter were flying from an airfield south-east of Townsville, Qld to a farm to have lunch. On the return trip, they flew via a waterfall at Mount Elliott, about 25 km southeast of Townsville. The pilot reported that on flying up to the waterfall area, he realised that he was a bit low and decided to make a left turn and increase throttle to maximum. As he applied full power, the slipper clutch malfunctioned resulting in a loss of rotor revolutions per minute (RPM). The gyrocopter's airspeed started to reduce rapidly and the gyrocopter began to sink. Due to a ridge in front of the aircraft, the pilot decided to make a forced landing in a wooded gully. The aircraft landed upright on a log in a thick, vined tree canopy, but the pilot broke his leg in the accident. The pilot had an emergency locator transmitter (ELT) which he activated, and was able to contact search and rescue via mobile telephone to organise aeromedical retrieval.

Aircraft control

Most of the 32 aircraft control issues reported in recreational aviation in 2013 where an accident or serious incident occurred where hard landings and losses of control. None of these resulted in serious or fatal injuries to the occupants. Most involved fixed-wing aeroplanes, compared to 2012 where most involved weight shift aircraft.

Loss of control accidents and serious incidents most commonly involved ground loops, or bouncing on landing due to a gust. In many cases, this was followed by the aircraft veering off the side of the runway, a wingtip contacting the ground, or in some cases the aircraft flipping over.

Hard landings did not always result in a loss of control. The 12 accidents and serious incidents reported in 2013 generally involved windshear or a gust resulting in the aircraft landing heavily or bouncing. In all of these cases the landing gear or propeller was substantially damaged, and in cases where the aircraft also ground looped, there were reports of wing damage.

Most loss of control accidents were associated with a weight shift aircraft (either a hang glider or paraglider) pilot losing control in turbulence.

All but one of those accidents and serious incidents involving aeroplanes involved a loss of control during take-off or landing. Where a contributing factor to the loss of control was reported to the ATSB, crosswinds and gusts were a common theme in these accidents. In most cases, aircraft damage or injuries to the occupants were due the aircraft colliding with an obstacle off the side of the runway, such as a fence or tree.

Other aircraft control-related accidents and serious incidents involving recreational aviation aircraft in 2013 included wheels-up landings, and overrunning the runway due to an incorrect aircraft configuration on landing.

Runway events

All but one of the 15 runway events involving recreational aviation aircraft that resulted in an accident or a serious incident were runway excursions (primarily veer-offs).Many of these accidents were associated with a gust and loss of control on the runway, as discussed earlier in this section.

The remaining serious incident was a runway incursion between a recreational aircraft and a GA aircraft, which attempted to take off from opposite ends of the same runway at the same time.

ATSB occurrence 201312954

Passing 100 ft on climb after take-off from Busselton Airport, WA, the engine ran rough and the pilot of the Aeroprakt A22 Foxbat conducted a precautionary landing resulting in the aircraft overrunning the runway. During a subsequent test flight, the engine failed and the pilot conducted a forced landing at Busselton. An inspection revealed that an extension of the fuel vent, which had been completed during previous maintenance, was the cause of the engine failure.

ATSB occurrence 201310207

The pilots of an Aeronca 11AC and an SG Storm 300 commenced take-off from the opposite ends of the same runway at Wedderburn, NSW. When lined up for take-off, the pilot of the Storm made a broadcast on the CTAF asking the Aeronca pilot who should take off first. After receiving no answer, the pilot of the Storm broadcast again that he would go first. Again receiving no answer, the pilot assumed that the Aeronca pilot was allowing him to take off first. Just after the Storm became airborne, the pilot saw the Aeronca taking off as well. The Storm pilot increased his rate of climb, while the Aeronca pilot flew low along the runway to ensure separation was maintained. The aircraft passed about 300 ft apart. It was subsequently determined that the pilots had over-transmitted each other on the CTAF while entering the runway.

Incidents

The most commonly reported types of incidents to the ATSB in 2013 that involved recreational aviation operations were engine malfunctions, aircraft control issues, and runway events (Table 34).

Table 34: Incidents in recreational aviation operations, by occurrence type, 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Airspace											
Aircraft separation	2	3	3	3	3	9	4	5	5	5	42
Operational non-compliance	0	0	2	2	1	2	2	4	3	4	20
Airspace infringement	0	1	0	2	1	4	2	1	1	2	14
ANSP operational error	0	0	2	0	0	0	0	0	0	0	2
Environment											
Wildlife	0	0	0	2	2	2	3	5	0	5	19
Weather	0	0	0	0	2	0	3	3	2	2	12
Infrastructure											
Other	0	0	0	1	2	0	0	0	0	0	3
Operational											
Aircraft control	0	0	0	11	12	9	10	20	22	25	109
Terrain Collisions	0	0	0	14	16	6	14	21	16	19	106
Runway events	0	0	2	7	10	8	11	12	20	23	93
Communications	1	1	5	0	6	5	4	4	3	8	37
Flight preparation / Navigation	0	0	1	1	2	1	1	3	4	3	16
Fumes, Smoke, Fire	0	0	0	1	3	1	2	2	3	4	16
Fuel related	0	0	0	2	3	0	1	2	4	2	14
Ground operations	0	0	0	2	3	1	0	2	4	2	14
Miscellaneous	0	0	0	1	2	0	0	0	1	0	4
Aircraft loading	0	0	0	0	0	0	0	0	1	0	1
Crew and cabin safety	0	0	0	0	1	0	0	0	0	0	1
Technical											
Powerplant / propulsion	0	0	0	11	14	4	24	18	19	26	116
Airframe	0	0	0	6	10	8	12	19	16	19	90
Systems	0	0	0	2	1	1	3	6	9	5	90
Consequential events	1	1	1	8	16	8	29	20	28	21	133

Powerplant / propulsion

Engine malfunctions occurred in 26 reported incidents involving recreational aircraft in 2013. Almost all were abnormal engine indications, a partial power loss, or rough running. In most cases, the pilot was able to conduct a precautionary landing or make a diversion (forced outfield landings accounted for only a few incidents).

ATSB occurrence 201305715

During approach and landing at Yarram, Vic., the engine of the Skyfox CA25 ran roughly. An engineering inspection revealed that a piece of mesh from inside the air cleaner had lodged in the left carburettor and had jammed the slide in the mid power range.

ATSB occurrence 201312025

During cruise, the RAF 2000 gyrocopter developed severe airframe oscillations and the pilot conducted a precautionary landing on a road near Kingaroy, Qld. The rotor head was overhauled, including the bearings and teeter bolt (wear of this bolt can cause the symptoms experienced during the flight).

Aircraft control issues

The 25 aircraft control incidents reported to the ATSB in 2013 involving recreational aircraft were mostly hard landings or loss of control events that were recovered by the pilot. Issues included airframe oscillations in a gyrocopter, a canopy opening during take-off, incorrect paraglider control inputs, and loose components in a nose wheel resulting in directional control problems during landing.

ATSB occurrence 201301343

During the take-off run at Gawler, SA, the canopy of the Zenith CH601 opened. The canopy cover, located behind the pilot's seat, blew out and wrapped around the aircraft's tail. The pilot's headset and hat blew off. The aircraft had reached about 15 ft AGL, and the pilot rejected the take-off by lowering the nose. The pilot overcorrected and the aircraft bounced then landed heavily resulting in minor damage.

Runway events

There were 23 runway events involving a recreational aircraft reported to the ATSB in 2013, most of which were runway excursions (15). Most of these excursions were veer-offs on landing, due to a landing gear mechanical issue (wheel detached, brake failure, loose pin in nose gear leg), or due to a crosswind.

Five runway incursions and three incidents in which an aircraft operated from an incorrect runway were also reported. These involved landing at a closed aerodrome, and entering a runway and commencing take-off while a ground vehicle was occupying the runway.

Data sources and submissions

Sources of information

The sources of information during the investigation included:

- the ATSB occurrence database
- ATSB investigation reports
- aircraft and operator activity data from the Bureau of Infrastructure, Transport and Regional Economics (BITRE).

Appendices

Appendix A – Explanatory notes

Occurrence data represent a picture of aviation derived from information available at the time these statistics were prepared.

This appendix explains what data was included or excluded to produce these statistics, how operation types are defined, and other important points to consider when interpreting these statistics.

Inclusions

Specifically, occurrence data includes:

- the number of aircraft involved in incidents, serious incidents, serious injury accidents, fatal accidents and total accidents
- the number of serious injuries and fatalities
- accident and fatal accident rates per million departures and million hours flown.

Exclusions

Fatalities do not include those resulting from:

- parachuting operations where aircraft safety was not a factor
- suicides
- criminal acts.

Important points to consider

A number of procedures are used in different sections of this report to distinguish occurrences from aircraft and injuries.

- An occurrence may involve one or more aircraft.
- Where occurrence data is presented by operation type or occurrence type (as in the Occurrences by operation type and Occurrence types: what happened sections of this report), tabulated figures refer to the number of aircraft involved in occurrences. Occurrences involving more than one aircraft are recorded once for each aircraft involved.
- Aircraft involved in fatal accidents are counted based on what happens to the aircraft occupants. This means that each aircraft with an onboard fatality is counted separately as being involved in a fatal accident within the operation type of the aircraft. If two aircraft collide in mid-air and fatalities occur onboard both aircraft, two aircraft involved in fatal accidents are counted. Using the same example, if two aircraft collide in mid-air and a fatality occurs on one aircraft only, one aircraft is recorded as being involved in a fatal accident, but in total, two aircraft are recorded as being involved in accidents.
- Injuries and fatalities are recorded against only the operation type of the aircraft in which the injury or fatality occurred.
- Tables in this report record aircraft where the registration or flight number is known and/or where the operation type can be reasonably ascertained. For example, aircraft operating in Class G airspace without a transponder or flight plan can be reasonably expected to belong to general aviation, even though the operation subtype is not known.
- Where an occurrence has more than one level of injury, the highest injury level is recorded. For example, an accident involving an aircraft with four occupants may have one person with no injury, one person with minor injury, one person with serious injury, and one person with fatal injuries; this aircraft will be recorded as being involved in a fatal accident only.

- The number of serious injuries are derived from both fatal accidents that involve some serious injuries, and from serious injury accidents (serious injury accidents represent occurrences where serious injury is the highest injury recorded.)
- It is important not confuse serious injury accidents and serious incidents. A serious incident is an incident where an accident nearly occurred. In contrast, a serious injury accident involves an occurrence resulting in the highest injury that requires, or would usually require, admission to hospital within 7 days after the day when the injury is suffered.
- The high-level categories of all air transport, all general aviation and all recreational aviation include occurrence data where the country of registration is not known, but the general type of operation is known. This means that the addition of sub-categories will be less than the total number at the higher level.

Operation types

This report provides data pertaining to a number of operational types, which are utilised across a wide range of ATSB statistical and research reports.

Commercial air transport refers to scheduled and non-scheduled commercial operations used for the purposes of transporting passengers and/or cargo for hire or reward. Specifically, this includes:

- *High capacity regular public transport (RPT) and charter* - regular public transport operations[22] and charter operations conducted in high capacity aircraft. A high capacity aircraft refers to an aircraft that is certified as having a maximum capacity exceeding 38 seats, or having a maximum payload capability that exceeds 4,200 kg.
- *Low capacity RPT* - regular public transport operations conducted in aircraft other than high capacity aircraft. That is, aircraft with a maximum capacity of 38 seats or less, or having a maximum payload capability of 4,200 kg or below.
- *Charter* - operations involving the carriage of passengers and/or cargo on non-scheduled flights by the aircraft operator, or by the operator's employees, for trade or commerce (excluding RPT operations). In this report, charter operations (for both occurrences and departures/hours flown) mostly refer to charter operations in low capacity aircraft.[23]

General aviation (GA) is considered to be all flying activities that do not involve scheduled (RPT) and non-scheduled (charter) passenger and freight operations. It may involve Australian civil (VH–) registered aircraft, or aircraft registered outside of Australia. General aviation includes:

- Aerial work. This includes ambulance, medivac, and other emergency medical service flights; and flying for the purposes of agriculture, mustering, search and rescue, fire control, or survey and photography.
- Flying training.
- Private, business and sports aviation. Sports aviation includes gliding, parachute operations, ballooning, warbird operations, and acrobatics.

In these statistics, GA does not include operations involving Australian non-VH registered aircraft (such as military aircraft, or aircraft registered by recreational aviation administration organisations (RAAOs).

Recreational aviation refers to all flying conducted for pleasure involving aircraft registered in Australia by RAAOs. These organisations have been authorised by the Civil Aviation Safety

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[22] RPT operations are conducted in accordance with fixed schedules to and from fixed terminals over specific routes.

[23] In the ATSB online aviation occurrence database, closed charter operations are generally coded as 'low capacity' operation type with 'charter' as an operation sub-type. Other charter occurrences in low capacity aircraft is coded as an operation type of 'charter'.

Authority (CASA) to maintain registers of aircraft and conduct administration of recreational flying. Recreational aviation aircraft include those registered with:

- Australian Sports Rotorcraft Association (ASRA) (gyrocopters with a G– registration)
- Hang Gliding Federation of Australia (HGFA) (weight shift aircraft, such as hang gliders, paragliders, powered parachutes, weight shift trikes and microlights with a T1– or T2– registration)
- Recreational Aviation Australia (RA-Aus) (registrations in the 10-, 19-, 24-, 25-, 28-, 32-, and 55- series). These encompass a wide range of aircraft types, sizes, and performance levels, and may include fixed-wing aeroplanes or sport aircraft, amateur-built or experimental aircraft, weight-shift microlights, powered gliders and powered parachutes.

Reports of safety incidents involving military aircraft that have been reported to the ATSB are excluded from these statistics, unless the military aircraft has affected the safety of a civil aircraft.

Occurrence types and events

Not all notifications reported to the ATSB are classified as incidents, serious incidents or accidents. Those that are deemed to not be a transport safety matter are classified as 'events'. Events are not included in this report.

Notifications of the following occurrence type events *when they occur without any other occurrence type event* are coded as events:

- consequential events (diversion / return, fuel dump / burn off, missed approach / go-around)
- operational non-compliance with air traffic control verbal or published instruction
- airspace infringement
- breakdown of co-ordination between air navigation service providers.

Note that previous editions of *Aviation occurrence statistics* did include operational non-compliance, airspace infringement and breakdown of co-ordination as incidents.

In addition, Infrastructure related events (air traffic management, Navigation aids, Radar / surveillance, Runway lighting) are coded as events when no aircraft was affected.

Appendix B – ATSB occurrence type taxonomy

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
Airspace	**Aircraft separation**	Airborne collision alert system warning
		Collision
		Loss of separation
		Loss of separation assurance
		Near collision
		Issues
	Airspace infringement	
	ANSP operational error	Information / procedural error
		Failure to pass traffic
		Other
	Breakdown of co-ordination	
	Operational non-compliance	
	Other	
Consequential events	**Ditching**	
	Diversion / return	
	Emergency evacuation	
	Emergency / precautionary descent	
	Forced / precautionary landing	
	Fuel dump / burn off	
	Missed approach / go-around	
	Rejected take-off	
	Other	
Environment	**Interference with aircraft from ground**	
	Weather	Icing
		Lightning strike
		Turbulence / windshear / microburst
		Unforecast weather
		Other
	Wildlife	Animal strike
		Birdstrike
		Other
	Other	
Infrastructure	**ATM**	
	Navaids	
	Radar / surveillance	
	Runway lighting	
	Other	
Operational	**Aircraft control**	Airframe overspeed
		Control issues
		Hard landing
		Incorrect configuration
		In-flight break-up

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		Loss of control
		Stall warnings
		Unstable approach
		Wheels up landing
		Other
	Aircraft loading	Dangerous goods
		Loading related
		Other
	Communications	Air-ground-air
		Call sign confusion
		Transponder related
		Other
	Crew and cabin safety	Inter-crew communications
		Cabin injuries
		Cabin preparations
		Depressurisation
		Flight crew incapacitation
		Passenger related
		Unrestrained occupants / objects
		Other
	Fire, fumes and smoke	Fire
		Fumes
		Smoke
	Flight preparation / navigation	Aircraft preparation
		Flight below minimum altitude
		Lost / unsure of position
		VFR into IMC
		Other
	Fuel related	Contamination
		Exhaustion
		Leaking or venting
		Low fuel
		Starvation
		Other
	Ground operations	Foreign object damage / debris
		Ground handling
		Jet blast / prop / rotor wash
		Taxiing collision / near collision
		Other
	Ground proximity alerts / warnings	
	Miscellaneous	Missing aircraft
		Security related
		Warning devices
		Other
	Runway events	Depart / approach / land wrong runway

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		Runway excursion
		Runway incursion
		Runway undershoot
		Other
	Terrain collisions	Collision with terrain
		Controlled flight into terrain
		Ground strike
		Wirestrike
Technical	**Airframe**	Doors / exits
		Furnishings and fittings
		Fuselage / wings / empennage
		Landing gear / indication
		Objects falling from aircraft
		Windows
		Other
	Powerplant / propulsion	Abnormal engine indications
		Auxiliary power unit
		Engine failure or malfunction
		Propeller / rotor malfunction
		Transmission and gearboxes
		Other
	Systems	Air / pressurisation
		Anti-ice protection
		Avionics / flight instruments
		Datalink (RPA)
		Electrical
		Fire protection
		Flight controls
		Fuel
		Hydraulic
		Other

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Glossary

Occurrence - an accident or incident.

Accident - an occurrence involving an aircraft where:

- a person dies or suffers serious injury
- the aircraft is destroyed, or is seriously damaged
- any property is destroyed or seriously damaged (*Transport Safety Investigation Act* 2003).

Incident - an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation (ICAO Annex 13).

Serious incident - an incident involving circumstances indicating that an accident nearly occurred (ICAO Annex 13).

Serious injury - an injury that requires, or would usually require, admission to hospital within seven days after the day when the injury was suffered (Transport Safety Investigation Regulations 2003).

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Aviation Research Statistics
Aviation Occurrence Statistics 2004 to 2013
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