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Addendum

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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 2015, Australia had 31 fatalities and 32 serious injuries – 28 aircraft were involved in fatal accidents and a further 28 in an accident resulting in serious injuries. There was a total of 227 aircraft involved in accidents, and 185 involved in serious incidents (indicating an accident nearly occurred).

- Commercial air transport had one fatality from nine accidents.
- General aviation had 12 fatalities from 130 accidents.
- Recreational aviation had 18 fatalities from 76 accidents.

For commercial air transport, 2015 had the lowest number of accidents in the study period (2006-2015). Seventeen of the 19 fatalities (2006-2015) involved aircraft conducting charter operations.

The majority of fatalities, in the 10-year period, occurred within general aviation. Around 20 per cent of fatal accidents resulted from a loss of control.

Growth in recreational (non-VH) flying and improving awareness of reporting requirements, led to more than a tenfold increase in the number of recreational safety incidents reported to the ATSB between 2006-2015.

The number of remotely piloted aircraft accidents and incidents increased significantly – from 14 occurrences within eight years (2006-2013) to 37 within the last two years (2014-2015) of the study period.

From 2006 to 2014 (activity data was not available for 2015), recreational aircraft, search and rescue, private/business and sports aviation, and aerial agriculture operation types had the highest fatal accident rates (per hours flown). For all accidents, the highest accident rates occurred with recreational aeroplanes, followed by aerial agriculture, private/business and sport aviation, and recreational gyrocopters.

- Around 40 per cent of all recreational gyrocopter accidents resulted in fatalities and almost one-quarter of weight shift aircraft accidents were fatal.
- The highest general aviation accident rate in the study period was in 2014. However, that year also had the lowest fatal accident rate.
- In 2014, the flying training accident rate was more than double that of any year in the previous eight.

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 of accidents and incidents, and the analysis of data to identify emerging trends and identify issues before they lead to accidents.

The types of occurrences 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.[1]

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 responsible persons as defined in Part 2.5 of the Regulations provide occurrence data to the ATSB. The ATSB accepts no liability for any loss or damage suffered by any person or corporation resulting from the use of these statistics.

See *Appendix A – Explanatory notes* for definitions of aircraft operation types and a general explanation of the analysis approach. Definitions of occurrence categories appear in the *Glossary*.

NOTE 1:

In this edition of *Aviation occurrence statistics*, *Medical transport* operations are grouped with *Commercial air transport* operations. While consistent with the 2015 edition of this publication, previous editions grouped *emergency medical services* under *General Aviation – Aerial work*. This change is consistent with the Civil Aviation Safety Authority's Notice of Proposed Rule Making (NPRM) 1304OS, July 2013. The NPRM outlined that Medical transport flights will operate under the requirements of an Air transport Air Operator's Certificate (issued under CASR Part 119) and the applicable operational rule set (CASR Part 133 for helicopter operations and either Part 121 or 135 for aeroplane operations).

Consistent with the 2015 edition, this edition also combines occurrences involving mustering activities classified within *Private* operations with *Aerial work – Mustering.*

NOTE 2:

Although comparable with the previous edition of *Aviation occurrence statistics*, less incidents are shown in this edition than earlier (pre-2014) 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 these statistics since the 2014 edition. See Appendix A – Explanatory notes for more detail.

[1] www.atsb.gov.au/about_atsb/legislation.aspx

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*.

Table 1 and Table 2 display activity data used to calculate rates in this report. 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.

Aviation activity presented below have been grouped into the following operational types:

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

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 a more appropriate measure than hours flown as most accidents occur either during the approach and landing or departure phases of flight.

Departures data are not available for individual operation types within general aviation (GA) prior to 2014 and for any recreational aviation. The combined totals do not include medical transport (commercial air transport) or gliding (general aviation). At the time of publication, departures were only available to 2014 for most operation types, and to 2015 for some types of air transport.

Table 1: Departures (thousands), 2006 to 2015[2]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All commercial air transport (excl. medical transport)	1,269	1,318	1,311	1,278	1,382	1,405	1,475	1,443	1,335	N/A
High capacity RPT & charter (VH- registered)	421	439	491	493	537	559	612	621	622	626
Low capacity RPT (VH- registered)	180	168	141	128	133	143	154	146	128	126
Low capacity charter (VH- registered, estimated)[3]	624	667	633	609	662	651	655	618	524	N/A
Foreign-registered	43	44	46	48	50	52	53	58	61	59
All VH- registered general aviation (excluding gliding)	1,810	1,793	1,957	1,840	1,993	1,861	1,767	1,819	1,849	N/A

Commercial air transport operations and general aviation departures have remained relatively constant over the last 10 years. (Figure 1).

Within air transport, high capacity regular public transport (RPT) departures steadily increased from 2006 to 2012. Since then they have remained steady at around 620,000 departures per year. Low capacity RPT departures have decreased to around two-thirds their 2006 levels, while charter departures have remained relatively steady until 2014 where a significant decrease occurred[4] (Figure 2).

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2 Departures are not available for medical transport, recreational aviation or gliding.

3 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*. Low capacity charter departures prior to 2014 were estimated because departures were not recorded separately for different types of operations in the BITRE *General Aviation Activity Survey.* The estimation model calculated the rate of departures per hour flown for aircraft that only perform charter operations. It then used this ratio to estimate the number of charter-related departures for all aircraft based on the number of charter hours flown. Ratios were specific to aircraft type (aeroplane or helicopter) and number of engines (single or multi-engine). From 2014 low capacity charter departures are collected in the BITRE General Aviation Activity Survey.

4 In 2014, BITRE started a major reclassification of operation types in their *General Aviation Activity Survey*, including the specific collection of charter departures (which were previously estimated), and the specific collection of new operation types that previously would have been counted within charter. However, the current publication corrected for the latter change and used 2014 charter departures that were the equivalent of what was estimated for pre-2014.

Figure 1: Departures by operation type, 2006 to 2014

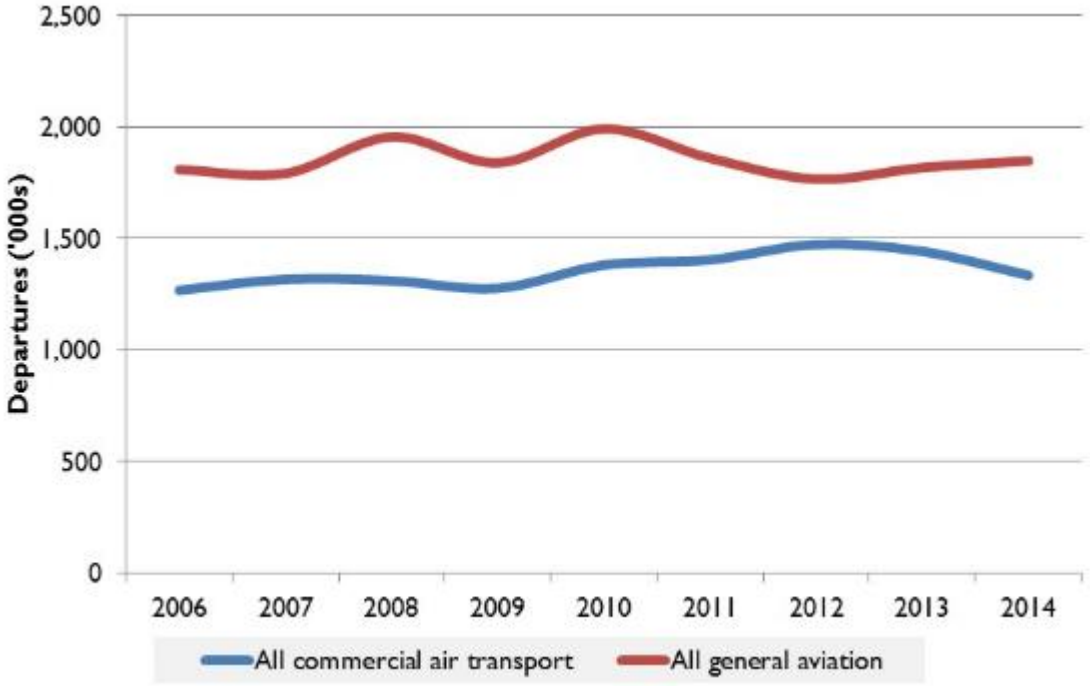
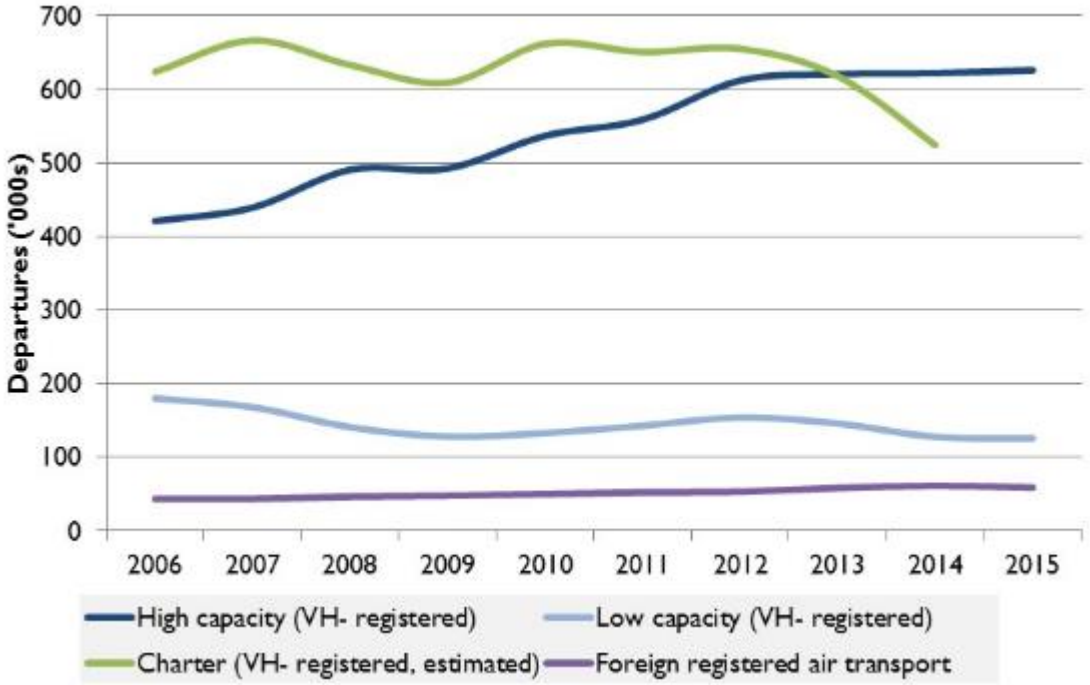


Figure 2: Departures in commercial air transport, 2006 to 2015



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[5] 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 2014 for most operation types.

Table 2: Hours flown (thousands), Australian-registered, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All commercial air transport (VH- registered)	1,720	1,816	1,858	1,798	1,947	2,011	2,145	2,098	1,980	N/A
High capacity RPT & charter	979	1,027	1,122	1,134	1,231	1,296	1,387	1,362	1,368	1,392
Low capacity RPT	181	167	133	111	117	139	156	147	125	121
Low capacity charter	481	547	521	471	509	487	504	488	383	N/A
Medical transport	79	75	82	81	90	88	97	100	104	N/A
All general aviation (VH- registered)	1,421	1,467	1,439	1,468	1,426	1,355	1,280	1,289	1,295	N/A
All aerial work	333	370	382	364	424	421	373	405	488	N/A
Aerial agriculture	62	62	78	73	104	100	89	80	76	N/A
Aerial mustering	102	113	113	106	118	126	113	125	145	N/A
Aerial search & rescue	7	9	9	7	6	7	6	6	10	N/A
Aerial survey	45	54	64	38	58	68	48	50	38	N/A
Flying training	429	461	490	501	440	391	365	384	333	N/A
Private/Business/Sport	374	379	382	390	384	384	365	365	363	N/A
Gliding	286	257	184	214	178	159	176	135	111	N/A
Recreational aviation (Non-VH/RAAO- registered)	247	259	281	311	287	301	352	330	281	N/A
Gyrocopters[6]	28	29	33	40	47	48	46	42	39	N/A
Recreational aeroplanes[7]	113	129	145	163	129	141	176	169	133	N/A
Weight Shift[8]	106	100	103	109	111	112	130	119	109	N/A

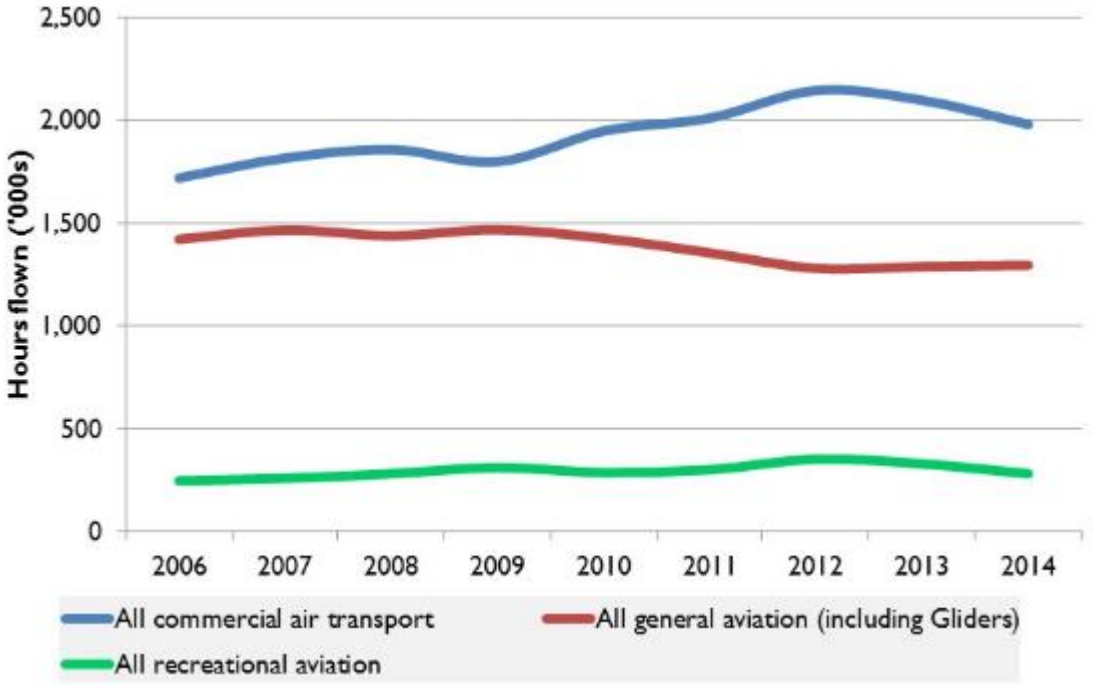
[5] Hours flown are not recorded individually for all types of aerial work that are reported on in these statistics (such as fire control) prior to 2014. Hours flown for several categories of aerial work were not collected by the BITRE prior to 2014, so hours flown for 'all aerial work' includes additional types of aerial work categories to those shown in Table 2. Similarly, for private/business/sport, only gliding flying activity is recorded separately.
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.

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

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

Air transport and recreational flying hours significantly increased from 2006 through 2012, but have since both dropped slightly. In contrast, general aviation steadily decreased with a flattening out over the last three years of the decade (Figure 3). In 2014, commercial air transport had 1.5 times more hours flown than GA. In turn, GA had nearly 5 times more hours flown than recreational aviation.

Figure 3: Hours flown by operation type, Australian-registered, 2006 to 2014



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 2006 and 2014. In contrast, the 2014 low capacity RPT hours flown were significantly less than 2006. Charter hours remained relatively static before dropping significantly in 2014.[9] Further, medical transport hours flown increased by approximately 30 per cent from 2006 to 2014 (Figure 4).

[8] Both the Hang Gliding Federation of Australia (HGFA) and RAAus 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.

[9] In 2014, BITRE started a major reclassification of operation types in their *General Aviation Activity Survey*, including the specific collection of new operation types that previously would have been counted within charter. However, the current publication corrected for this change and used 2014 charter hours that were the equivalent of pre-2014.

Figure 4: Hours flown in VH-registered commercial air transport, 2006 to 2015

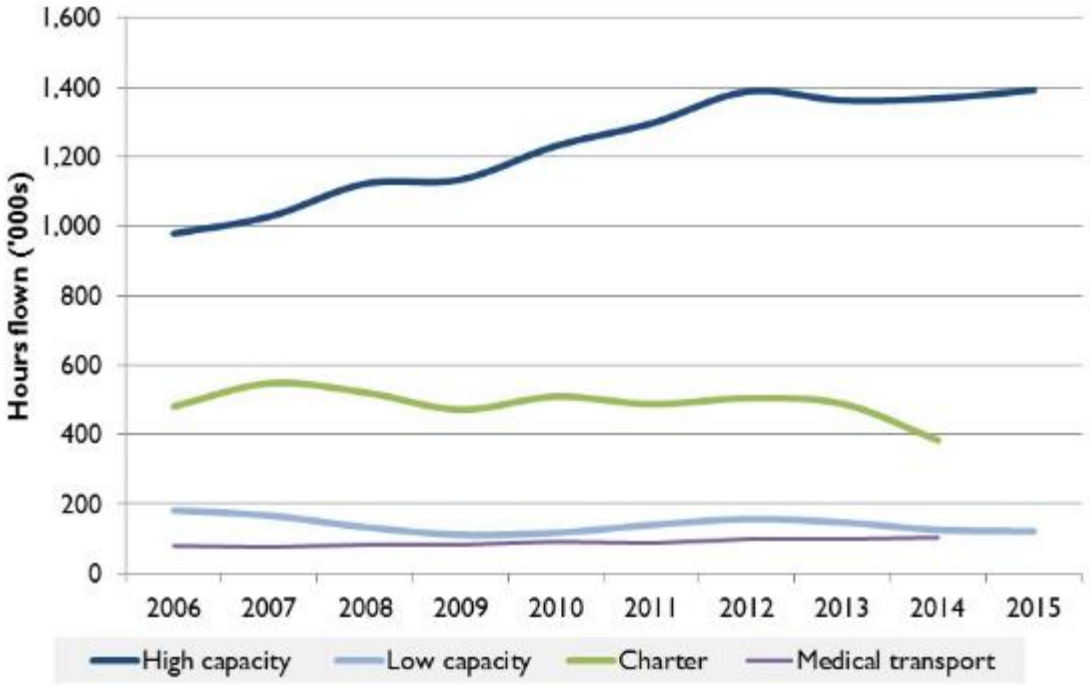


Figure 5 shows a comparison of flying activity across GA. Flying training has fallen by more than 30 per cent since its peak in 2009. Private/business/sport activity has steadily reduced over the 10 years by about 25 per cent as a result of gliding activity decreasing – down around 60 per cent. Excluding gliding, private/business/sport activity has been steady across the 10 years. All aerial work and aerial mustering increased by around 40 per cent and Aerial agriculture around 20 per cent. Other types of GA had steady flying activity from 2006 to 2014.

Aerial work makes up around one-third of all GA flying hours.

Figure 5: Hours flown in general aviation, 2006 to 2014

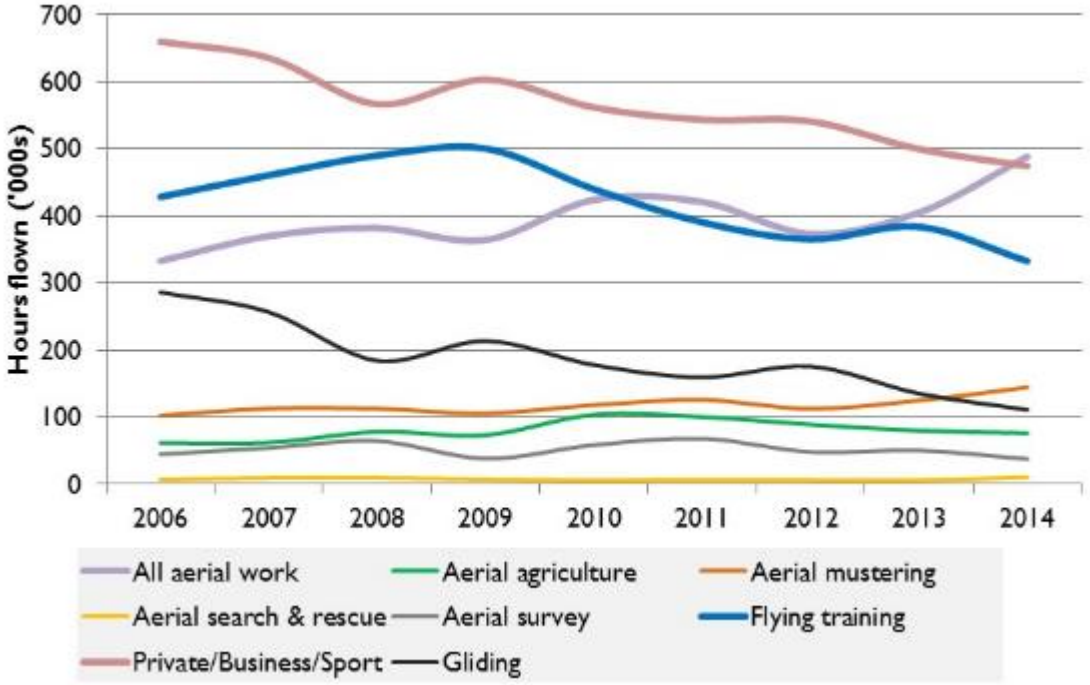
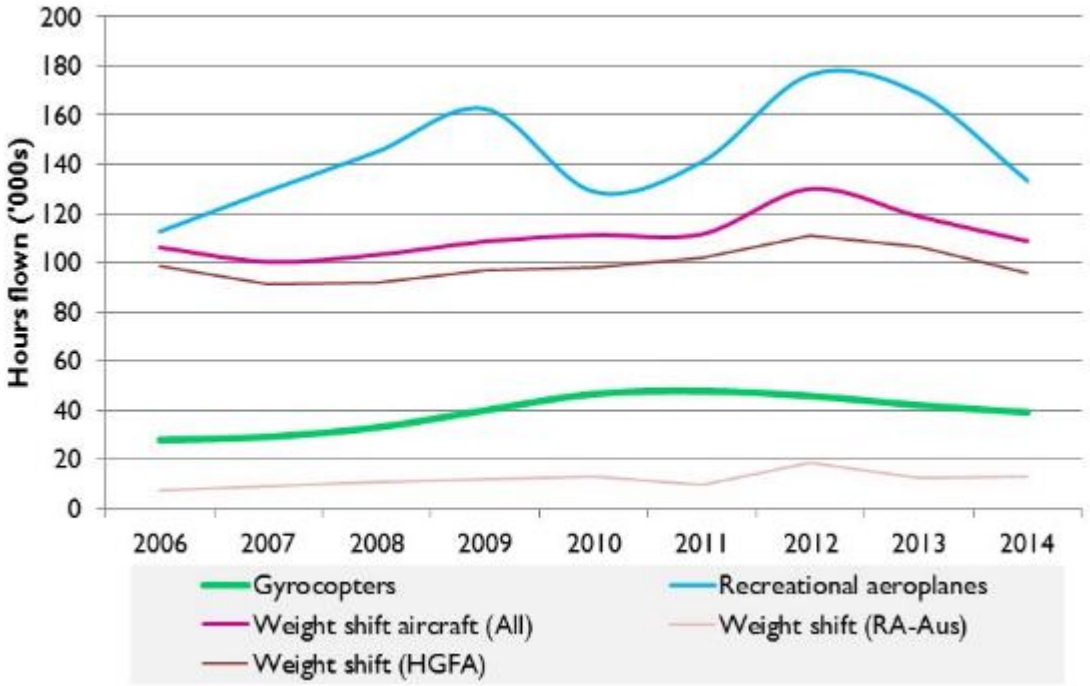


Figure 6 shows a comparison of flying activity for Australian (non-VH) recreational aviation across different types of RAAO, as reported by each RAAO to the BITRE. Flying hours of RAAus registered recreational aeroplanes have significantly increased up to 2012, but has declined since then. Although representing only 14 per cent of recreational aviation activity, gyrocopters have had the most significant increase – within recreational operations – over this period of around 40 per cent.

Figure 6: Hours flown in recreational aviation, 2006 to 2014



More aviation activity statistics are available from the BITRE website.[10]

[10] www.bitre.gov.au

Occurrences by operation type

Occurrence numbers and rates presented through 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, charter flights and medical transport.
- **General aviation** - aerial work operations, flying training, and private, business and sports (including gliding) aviation (VH– or foreign-registered).
- **Recreational aviation** – aircraft being used for recreational flying that are registered by a recreational aviation administration organisation (RAAO).
- **Remotely piloted aircraft operations** – all operations using remotely piloted aircraft (RPA) approved by the Civil Aviation Safety Authority.

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,[11] 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*.

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. In contrast, survey/photography aircraft generally have a pilot, as well as camera operators or navigators, on board, so there were twice as many fatalities as fatal accidents in the last 10 years.

[11] 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), 2006 to 2015

Operation type	Number of aircraft associated with a fatality	Number of fatalities
Commercial air transport	**13**	**19**
High capacity RPT	0	0
Low capacity RPT	1	2
Charter	12	17
Medical transport	0	0
Foreign registered air transport	0	0
General aviation	**154**	**231**
Aerial work	48	60
Agriculture	16	16
Mustering	13	14
Search & rescue	2	2
Fire control	3	3
Survey and photography	8	16
Other	6	9
Flying training	8	11
Private/Business/Sport	97	159
Private/Business	80	138
Sport aviation (excluding gliding)	5	5
Gliding[12]	12	16
Foreign registered general aviation	1	1
Recreational aviation	**91**	**110**
Gyrocopters	17	19
Aeroplanes	44	56
Weight Shift	30	35
Total	***258***	***360***

Figure 7 below shows the rate of accidents and of fatal accidents for each of the specific operation types[13] 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. – While RAAus-registered aeroplanes had the highest accident rate, GA aerial agriculture and private/business/sport flights had higher accident rates than recreational gyrocopters and weight shift aircraft.

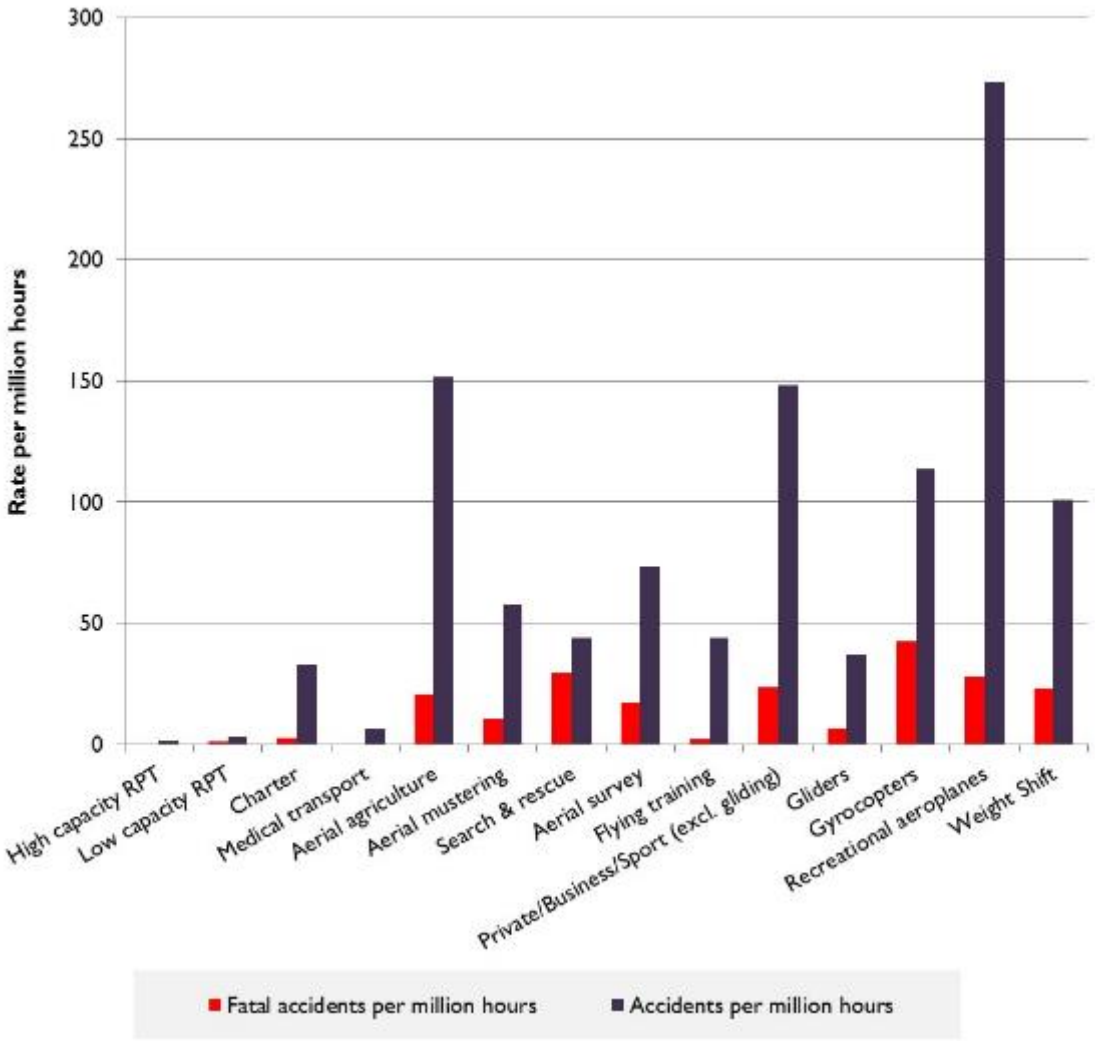
All recreational aircraft, private/business/sport, search & rescue, and aerial agriculture operation types were among the most likely to result in a fatal accident when considering the amount of

[12] Includes two motorised gliders.

[13] Activity data for each operation type was provided by BITRE, except for the following: Fire control, Other/unknown GA, Foreign-registered GA. Accident and fatal accident rates are based on those accidents from 2006 to 2014 only, as activity data was not yet available for 2015 at the time of writing. Private/Business/Sport excludes gliding.

flying activity. However, almost 40 per cent of all gyrocopters accidents were fatal (and gyrocopters also had the worst fatal accident rate per million hours flown). About one quarter of both weight shift aircraft and aerial survey and photography accidents were fatal. Two out of three search and rescue accidents were fatal. Note that reporting of accidents to the ATSB from the recreational operations has markedly increased since 2006 due to a greater awareness of reporting responsibilities in that sector. As such, the accident rate in more recent years is higher – see the *Recreational aviation* section below (page 46) for more details. 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, 2006 to 2014[13]



Commercial air transport

The number of reported safety incidents in commercial air transport increased over the last 10 years (Table 4). This is an indication of the increase in flying activity in most types of air transport, and the operators' greater awareness of their reporting requirements to the ATSB. Around 25 per cent of all commercial air transport incidents reported to the ATSB involved birdstrikes.

Serious incidents are indicators of events that almost led to accidents. They represent occurrences which could have had more serious consequences. The number of serious incidents in 2015 in commercial air transport was consistent with the 10-yearly average. This was a significant decrease from the peak in 2013.

There were nine accidents involving commercial air transport in 2015. One-third of these were charter and another third were high capacity air transport. This was the lowest number of accidents in the study period.

There was one fatal accident in 2015 involving an aircraft conducting charter operations. The number of serious injury accidents (4) was consistent with the 10-year average. These numbers were low in comparison to other types of aviation.

Table 4: All commercial air transport occurrences (VH- and foreign registered aircraft), 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	3,081	3,152	3,336	3,162	3,477	4,002	4,222	4,404	4,311	3,765
Serious incidents	16	47	52	27	37	28	47	54	36	29
Serious injury accidents	0	1	3	4	2	2	2	2	5	4
Fatal accidents	1	2	3	0	1	2	1	2	0	1
Total accidents	12	21	28	14	23	21	14	15	27	9
Number of people involved										
Serious injuries	0	1	15	6	2	2	2	4	7	5
Fatalities	2	2	6	0	2	2	1	3	0	1
Rate of aircraft involved										
Accidents per million departures	9.5	15.9	21.4	11	16.6	14.9	9.5	10.4	20.2	N/A
Fatal accidents per million departures	0.8	1.5	2.3	0	0.7	1.4	0.7	1.4	0	N/A

Figure 8: Commercial air transport occurrence and injuries, 2006 to 2015

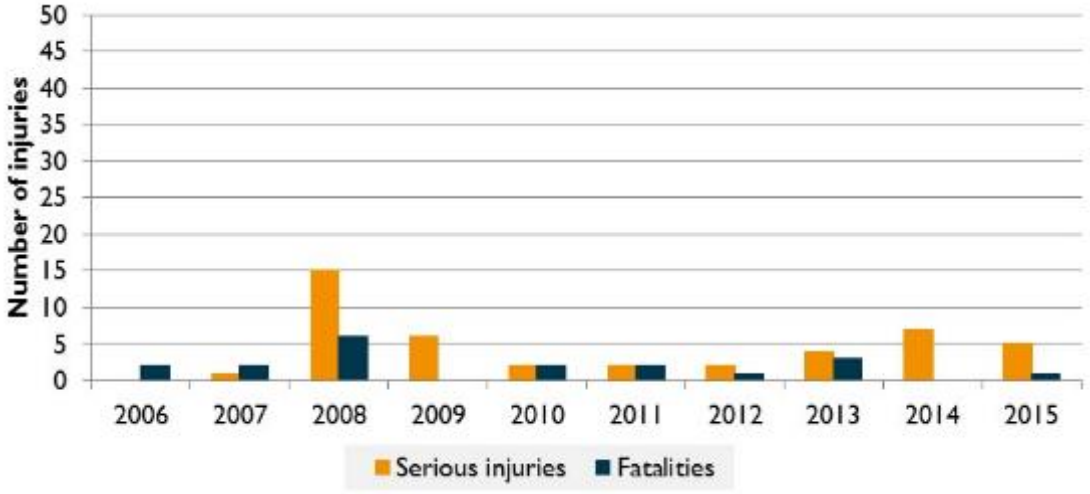
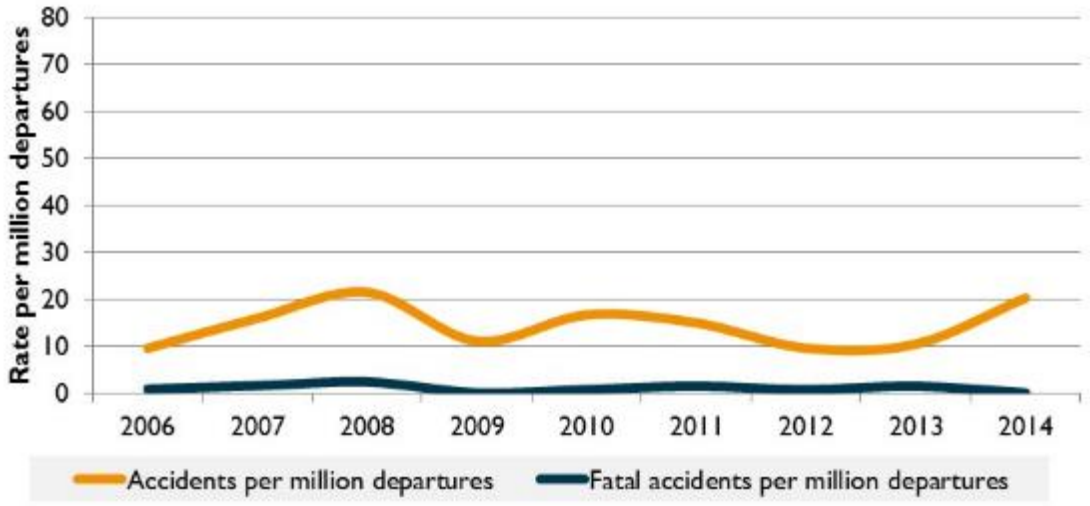


Figure 9: Commercial air transport accident and fatal accident rate (per million departures), 2006 to 2014



High capacity RPT and charter (VH- registered)

The number of incidents reported to the ATSB involving VH- registered high capacity RPT has risen by around 40 per cent in the last 10 years. This is consistent with the increase in the rate of departures (50 per cent) over this time. That is, the incident to departures ratio has remained relatively constant. Provided these trends remain constant, the number of reported incidents would double every 18 years, with departures doubling every 16 years.

The most commonly reported safety incident to the ATSB in 2015 concerning high capacity RPT involved birdstrikes.

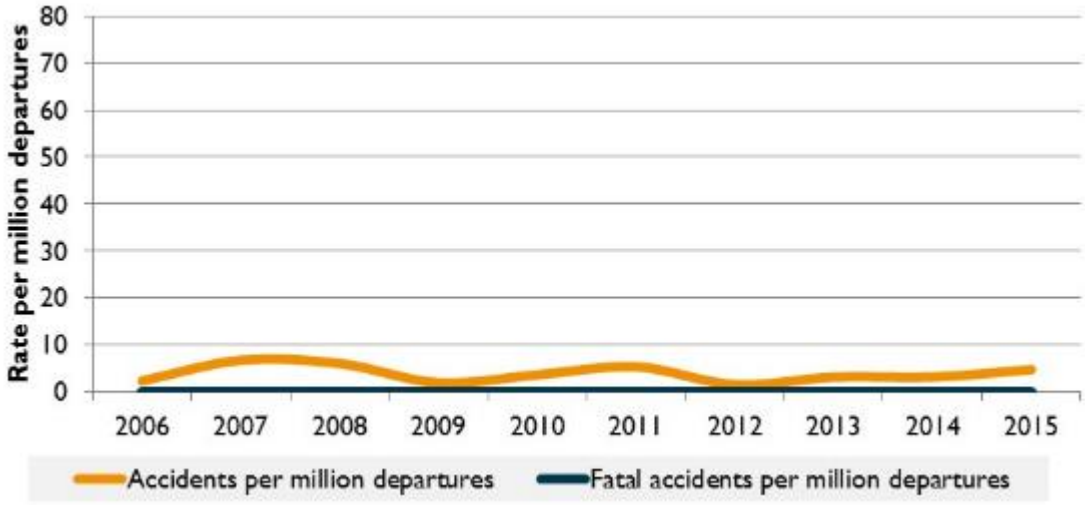
The number of accidents in 2015 was consistent with the 10-year average, however, the number of serious incidents was significantly lower.

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

Table 5: High capacity RPT (VH- registered aircraft) occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	1,900	1,916	2,129	2,016	2,428	2,853	3,106	3,288	3,214	2,670
Serious incidents	4	16	20	10	13	13	12	23	13	4
Serious injury accidents	0	1	1	1	2	1	0	1	1	2
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	1	3	3	1	2	3	1	2	2	3
Number of people involved										
Serious injuries	0	1	12	1	2	1	0	1	1	2
Fatalities	0	0	0	0	0	0	0	0	0	0
Rate of aircraft involved										
Accidents per million departures	2.4	6.8	6.1	2	3.7	5.4	1.6	3.2	3.2	4.8
Fatal accidents per million departures	0	0	0	0	0	0	0	0	0	0
Accidents per million hours	1	2.9	2.7	0.9	1.6	2.3	0.7	1.5	1.5	2.2
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), 2006 to 2015



There were three accidents and four serious incidents involving VH-registered aircraft high capacity RPT operations in 2015. These are described below:

- A passenger was seriously injured when an Airbus A320 flight, from Brisbane to Sydney, encountered turbulence during climb (ATSB occurrence 201501242).
- A passenger was seriously injured by an aircraft fitting on-board an Airbus A320 flight from Sydney to Launceston (ATSB occurrence 201501154).
- An ATR 72 was substantially damaged at Moranbah, Qld, during preparation for departure, when high winds caused the wing tip to strike the ground (ATSB occurrence 201505343).
- During the approach at Kosrae, Micronesia, a Boeing 737 from Majuro, Marshall Islands, flew below the minimum safe altitude in instrument metrological conditions (IMC) conditions and performed a missed approach. The investigation is continuing (ATSB investigation AO-2015-066).

- On departure from Melbourne, during take-off roll, the pilot of an Airbus A321 noticed the aircraft was nose-heavy and required almost full aft control input to raise the nose. During the flight, the flight crew requested the cabin crew to confirm passenger numbers and locations. Updated information was entered into the flight management computer and it was identified the aircraft was outside the loading limits for take-off and landing. Ten days earlier, the flight crew on another aircraft from the same airline – an A320 – requested the cabin crew to confirm passenger numbers. The count suggested the aircraft departed Brisbane with 16 more passengers than advised, resulting in a 1,328 kg discrepancy with the take-off weight. The crew recalculated the aircraft's landing data prior to descent into Melbourne. The investigation in continuing (ATSB investigation AO-2015-139).
- During descent into Sydney, fire was detected in an Airbus A320 oven and was extinguished by the crew. The source of the fire was determined to be from a headset placed in the oven (ATSB occurrence 201505712).
- During cruise, on a flight from Melbourne to Singapore, the crew of a Boeing 787 reported difficulty maintaining their assigned altitude followed by faulty flight instruments. The crew dumped fuel before diverting to Darwin. The aircraft landed safely. The investigation in continuing (ATSB investigation AO-2015-149)

Low capacity RPT (VH- registered)

In contrast to other types of commercial air transport, the number of incidents reported to the ATSB involving low capacity RPT aircraft has significantly declined over the last 10 years. This is primarily due to the decline in flying activity over this period (in both hours and 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 low capacity flights into the high capacity type), and the additional regional travel options provided by high capacity RPT operators.

The most commonly reported incident involving low capacity RPT incidents in 2015 was birdstrikes.

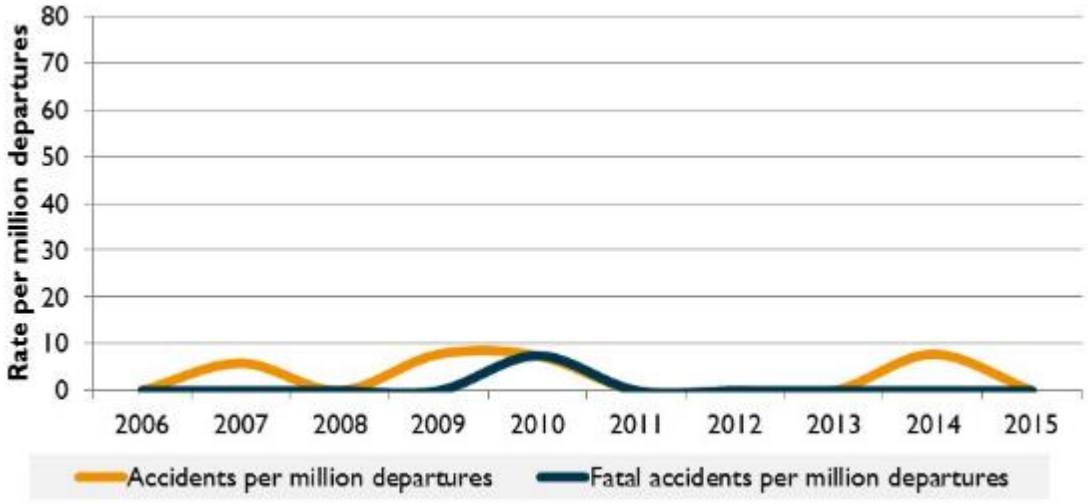
The number of serious incidents (5) in 2015 was consistent with the 10-year average of around five per year. There were no accidents in 2015 involving low capacity air transport aircraft.

No fatalities involving VH- registered low capacity RPT aircraft have occurred since 2010.

Table 6: Low capacity RPT (VH- registered aircraft) occurrences, 2006 to 2015

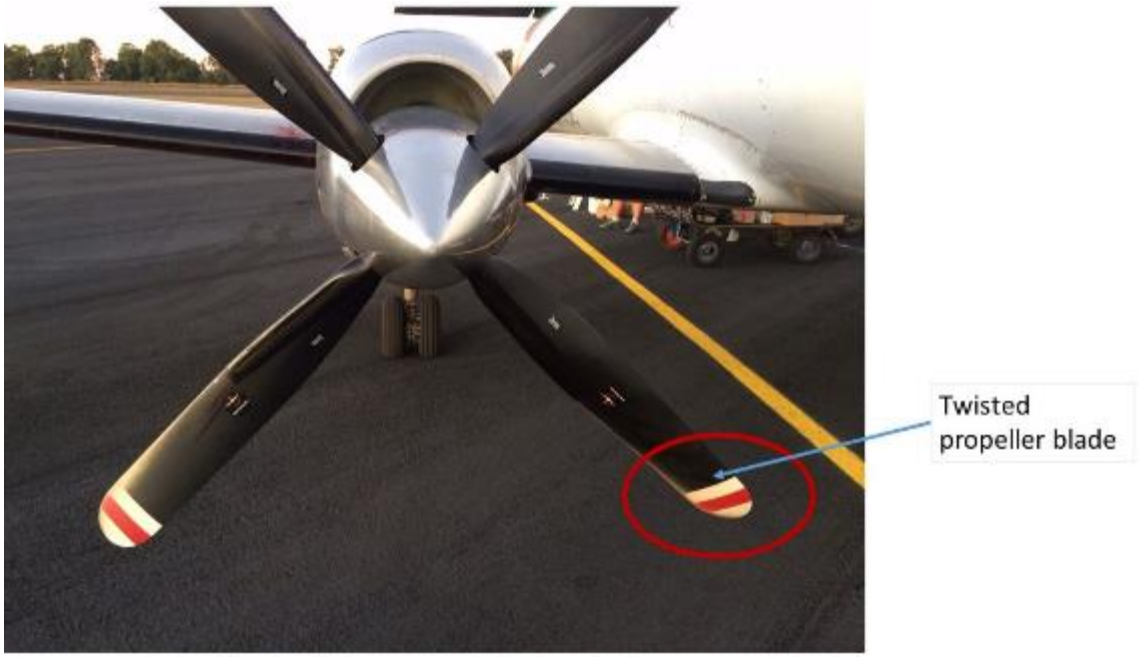
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	468	481	393	405	432	453	392	368	375	359
Serious incidents	5	8	11	4	6	2	5	3	1	5
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	1	0	0	0	0	0
Total accidents	0	1	0	1	1	0	0	0	1	0
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	2	0	0	0	0	0
Rate of aircraft involved										
Accidents per million departures	0	5.9	0	7.8	7.5	0	0	0	7.8	0
Fatal accidents per million departures	0	0	0	0	7.5	0	0	0	0	0
Accidents per million hours	0	6	0	9	8.6	0	0	0	8	0
Fatal accidents per million hours	0	0	0	0	8.6	0	0	0	0	0

Figure 11: Accident rate for low capacity RPT aircraft (VH- registered) (per million departures), 2006 to 2015



There were five serious incidents reported in 2015 that involved low capacity RPT operations. These are described below:

- Shortly after touchdown at Thangool, Qld, the right propeller of a Fairchild SA227 struck a small Kangaroo causing minor damage to the aircraft (ATSB investigation AO-2015-102).

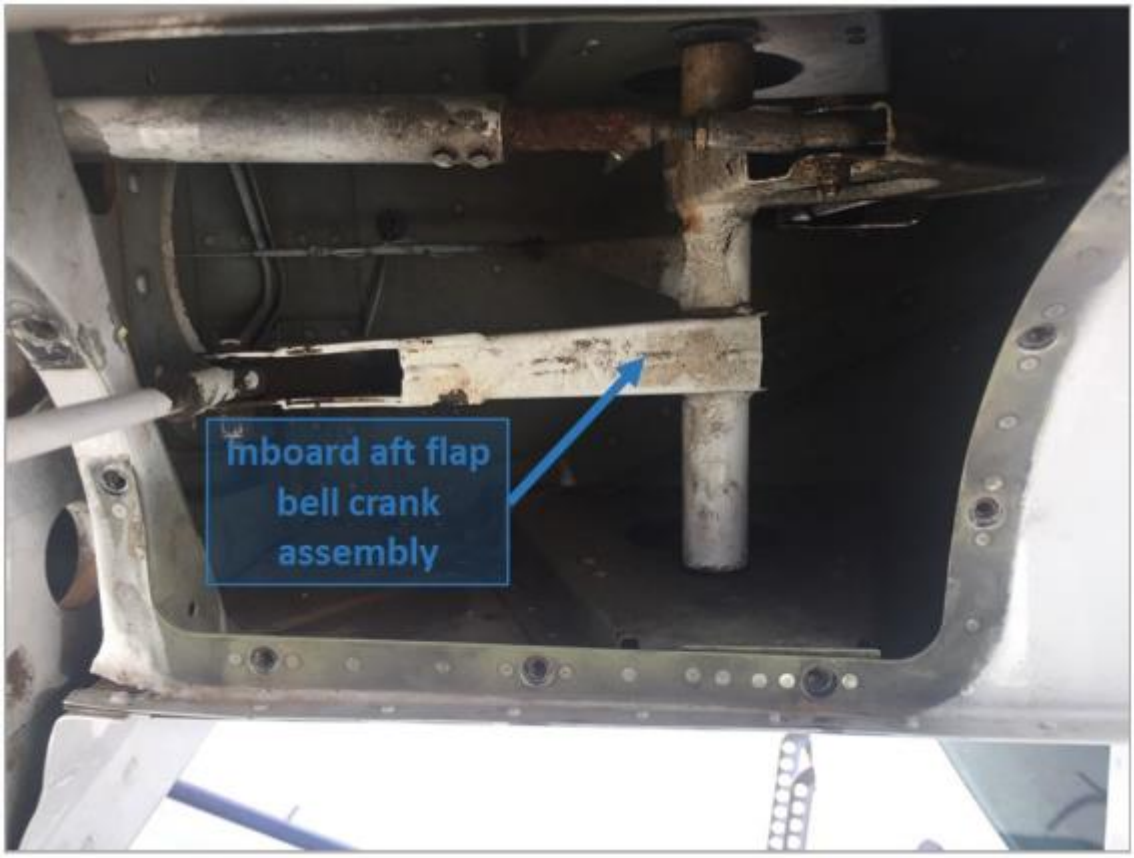


Collision with Kangaroo involving a Fairchild SA227 at Thangool, QLD on 1 September 2015 (ATSB investigation AO-2015-102) – right propeller. Source: Pilot

- During the landing at Moruya, NSW, a SAAB 340B struck multiple galahs. The crew conducted an inspection and the aircraft subsequently departed for Merimbula. On descent into Merimbula, the crew detected abnormal vibrations through the flight controls. After landing it was determined that a section of propeller was missing. The investigation is continuing (ATSB investigation AO-2015-007).
- During cruise, on a flight from Brisbane to Rockhampton, Qld, the autopilot of a Fairchild SA227 failed and the pilot encountered control issues. The aircraft returned to Brisbane. The

engineering inspection revealed a loose turn coordinator connector (ATSB occurrence 201507450).

- During descent into Snake Bay, Qld, the crew of the Cessna 404 took avoiding action after sighting a single-engine fixed wing aircraft in close proximity (ATSB occurrence 201507450).
- Shortly after final approach into Townsville Airport, Qld, as the pilot of a Cessna 208 selected the third and final stage of flap, a muffled bang was heard and the aircraft banked violently. The pilot regained control and landed the aircraft without incident. Engineering inspection revealed that a bolt from the after inner bell crank was missing. After further detailed inspection the company found that the manufacturer's inspection schedule in regard to the flap mechanism, although being complied with, was inadequate for their needs. The company have amended their maintenance schedule to include full inspections and life limitations to other structures in the flap mechanism (ATSB investigation AO-2015-133).



Flap system failure and loss of control involving a Cessna 208 at Townsville, QLD on 10 November 2015 (ATSB investigation AO-2015-133) – inboard aft flap bell crank assembly. Source: Operator.

Charter (VH- registered), low capacity

The number of incidents reported to the ATSB involving Australian-registered low capacity aircraft conducting charter work has been relatively stable for most of the last 10 years. Of all commercial air transport operations, charter generally has the highest total number and highest rates of accidents and fatal accidents over most years.

The number of accidents reported to the ATSB in 2015 involving charter aircraft dropped significantly to three from 23 in 2014. The reason for this drop is unknown though it is unlikely to be all due to a statistical anomaly. (Whether this was due to a drop in activity is unknown as charter activity for 2015 was unknown at the time of writing.) There was one fatal accident involving charter aircraft in 2015.

The accident and fatal accident rate per million hours was higher than for departures, which reflects the short duration of most charter flights and hence a greater exposure to approach and landing accidents (due to more departures per each hour flown).

The most commonly reported safety incident to the ATSB in 2015 concerning charter aircraft involved birdstrikes.

The number of serious incidents in 2015 was significantly higher than the 10-year average but was consistent with the recent average starting in 2012. There were no serious injury incidents in 2015.

Table 7: Charter (VH- registered aircraft) occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	465	521	553	492	357	401	398	398	395	444
Serious incidents	6	16	13	9	14	11	20	22	18	18
Serious injury accidents	0	0	2	1	0	1	2	1	4	0
Fatal accidents	1	2	3	0	0	2	1	2	0	1
Total accidents	10	16	25	8	20	18	12	12	23	3
Number of people involved										
Serious injuries	0	0	3	2	0	1	2	3	6	1
Fatalities	2	2	6	0	0	2	1	3	0	1
Rate of aircraft involved										
Accidents per million departures	16	24	39.5	13.1	30.2	27.7	18.3	19.4	43.9	N/A
Fatal accidents per million departures	1.6	3	4.7	0	0	3.1	1.5	3.2	0	N/A
Accidents per million hours	20.8	29.2	48	17	39.3	36.9	23.8	24.6	60.1	N/A
Fatal accidents per million hours	2.1	3.7	5.8	0	0	4.1	2	4.1	0	N/A

Figure 12: Accident rate for charter aircraft (VH- registered) (per million departures), 2006 to 2014

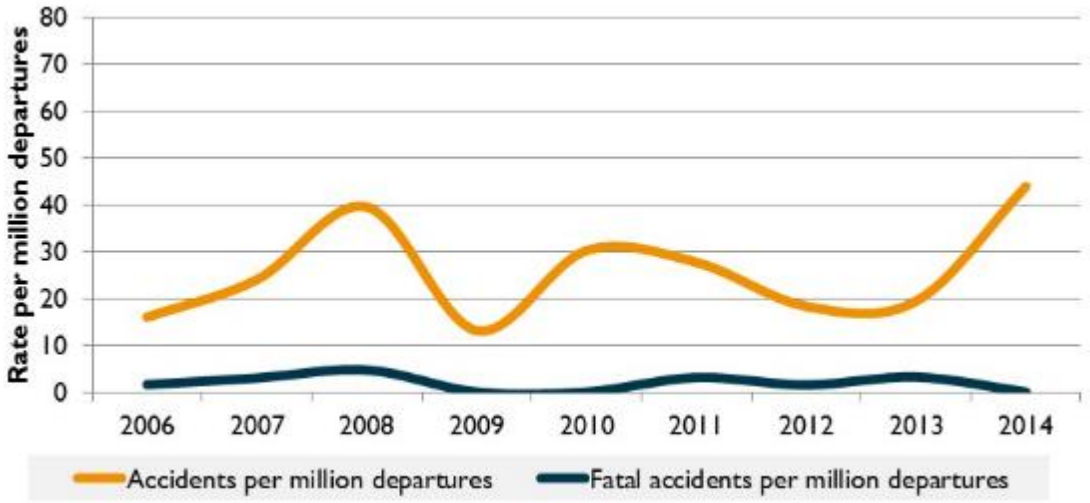
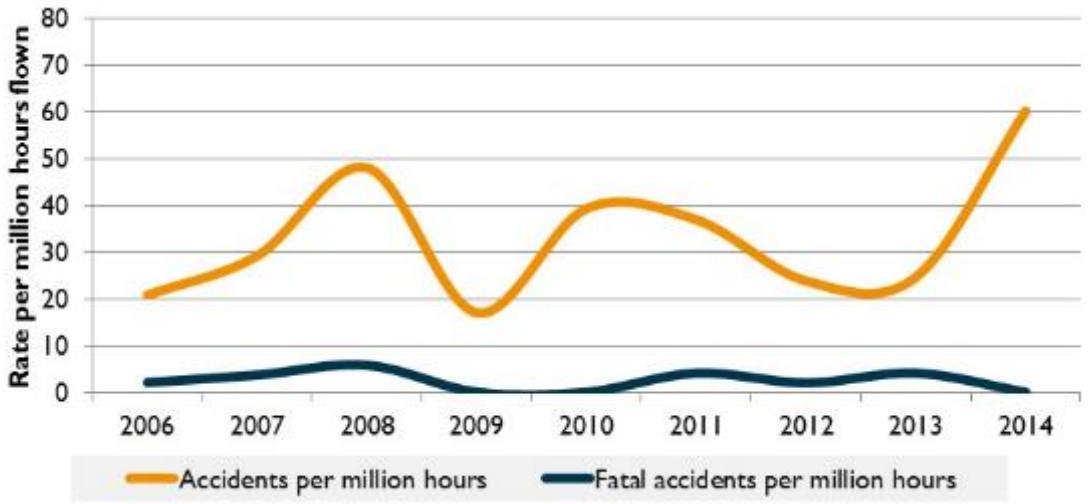


Figure 13: Accident rate for charter aircraft (VH- registered) (per million hours flown), 2006 to 2014



There were 21 VH- registered aircraft conducting charter work that were involved in accidents or serious incidents in 2015. Of the 18 aircraft involved in serious incidents, four were involved in near collisions and another four involved either a loss of separation in controlled airspace or other separation issues in uncontrolled airspace. The three accidents – including one fatal – are described below:

- An Aero Commander 500-U was substantially damaged after colliding with a fence and bush following a runway excursion at Badu Island, Qld. During take-off, just after rotation, the pilot detected a significant loss of power and rejected the take-off. Due to a wet runway surface, and a steep slope and trees beyond the end of the runway, the pilot decided to steer the aircraft towards open and level ground before the collision. The pilot and passengers were not injured (ATSB investigation AO-2015-028).

Runway excursion involving an Aero Commander 500-U at Badu Island, QLD on 8 March 2015. Source: Aircraft engineer.

- Two passengers sustained minor injuries when a Cessna 404 collided with terrain following a runway excursion on landing at Pantajin, WA. During the landing roll as the aircraft slowed

through about 60 kt, the pilot applied left rudder to turn the aircraft slightly to the left and increase separation from an overturned termite mound. The rudder pedals moved to the full left position and the aircraft turned to the left. The pilot immediately applied right rudder in an attempt to counteract the turn, but the aircraft initially continued to veer left towards the edge of the runway. As the aircraft veered off the runway and entered longer grass, the pilot regained control of the aircraft and it started to turn right and return towards the runway. The nose wheel then collided with a runway marker and collapsed, resulting in the aircraft nose contacting the ground. The aircraft skidded to a stop. The aircraft was substantially damaged (ATSB investigation AO-2015-038).

Collision with terrain following a runway excursion involving a Cessna 404 at Pantajin, WA on 12 April 2015. Source: Aircraft operator.

- A passenger was fatally injured and the pilot seriously injured when a de Havilland DH-82A Tiger Moth collided with terrain, following a loss of control, near Pimpama Airstrip, Qld. The ATSB investigation is continuing (ATSB investigation AO-2015-150).

Medical transport

The number of incidents involving medical transport aircraft reported to the ATSB in 2015 was high compared to the 10-year average, however, it was consistent with current average starting in 2012 (Table 8). Birdstrikes were the most commonly reported incident – around 27 per cent.

Table 8: Medical transport aircraft occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	98	92	121	123	100	114	149	136	159	141
Serious incidents	0	2	5	3	3	1	7	5	2	2
Serious injury accidents	0	0	0	2	0	0	0	0	0	1
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	0	1	0	3	0	0	0	1	0	1
Number of people involved										
Serious injuries	0	0	0	3	0	0	0	0	0	1
Fatalities	0	0	0	0	0	0	0	0	0	0
Rate of aircraft involved										
Accidents per million hours	0	13.4	0	36.8	0	0	0	10	0	N/A
Fatal accidents per million hours	0	0	0	0	0	0	0	0	0	N/A

In 2015 there was one accident and two serious incidents involving medical transport aircraft. These are described below:

- One person was seriously injured and another sustained minor injuries when a marque was blown over by the rotor wash of a Kawasaki Heavy Industries BK117 B-2 helicopter landing on a sports field at Blackheath, NSW (ATSB occurrence 201502890).
- A Raytheon B200, on an aeromedical flight to Jabiru, NT, returned to Darwin Aerodrome shortly after take-off due to a stall warning. The pilot discovered that the pneumatic boots fitted to the wing leading edges were inflated. The pilot deduced that the stall warning and relatively poor performance were attributable to the inflated condition of the boots. The pilot also noticed that the aileron control forces were abnormally light. The pilot tried to deflate the boots by cycling the surface de-ice control switch, but to no avail. The circuit and landing were uneventful, but the pilot noticed that substantially more power than normal was required to hold the desired speed. The wing de-ice boots remained inflated until the aircraft was parked and the engines were shut down. (ATSB investigation AO-2015-049).
- Near Darwin Aerodrome, a loss of separation occurred between an approaching Raytheon B200 and a climbing Cessna 441 conducting a charter flight. At the time of the occurrence, the pilot of the Cessna inadvertently selected the Brisbane Centre Frequency and was unable to hear Darwin Approach frequency (ATSB investigation AO-2015-061).

Foreign-registered air transport

Incidents reported to the ATSB involving foreign-registered air transport operations remained steady across the last 10 years. No foreign aircraft operating as air transport in Australia has been involved in fatal accidents in the last 10 years (Table 9).

Table 9: Occurrences involving foreign-registered air transport aircraft in Australia, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	146	137	131	120	143	159	159	188	162	144
Serious incidents	1	5	3	1	1	1	3	1	2	0
Serious injury accidents	0	0	0	0	0	0	0	0	0	1
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	1	0	0	1	0	0	1	0	1	2
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	1
Fatalities	0	0	0	0	0	0	0	0	0	0

There were two accidents involving a foreign-registered air transport aircraft reported to the ATSB in 2015:

- A crew member was seriously injured by an unrestrained wine chiller on an Airbus A330 flight from Melbourne to Jakarta (ATSB occurrence 201507111).
- An Airbus A330 from Kuala Lumpur was substantially damaged from a severe hard landing at Melbourne Airport. There were no injuries reported. The investigation in continuing (ATSB investigation AO-2015-032).

General aviation

General aviation (GA) is considered to be all flying activities of VH- registered aircraft outside of commercial air transport (scheduled (RPT) and non-scheduled (charter and medical transport) passenger and freight operations). It excludes recreational aircraft that are administered by recreational aviation administration organisations (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. Recreational aircraft statistics are reported separately below (page 46) in *Recreational aviation*. General aviation also excludes all remotely piloted aircraft operations, which are reported separately below (page 53) in *Remotely Piloted Aircraft*.

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

General aviation also accounts for over half of all aircraft movements across Australia (see Figure 1 on page 4). 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 GA compared to air transport in both fleet size and number of departures (but not hours flown), there are comparatively few occurrence reports sent to the ATSB. In 2015, there were 1,536 GA occurrences reported to the ATSB (Table 10). Although there is a less comprehensive reporting requirement under the Transport Safety Investigation Regulations than for aircraft not engaged in commercial air transport, the reporting rate is small when compared to the 3,803 occurrences involving commercial air transport aircraft reported to the ATSB in 2015.

The most commonly reported safety incident to the ATSB concerning GA in 2015 was birdstrikes.

Table 10: All general aviation occurrences (VH- and foreign registered aircraft), 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	1,653	1,596	1,607	1,795	1,550	1,502	1,401	1,393	1,258	1,293
Serious incidents	70	93	103	95	132	137	158	185	117	113
Serious injury accidents	8	7	16	8	15	12	8	6	14	10
Fatal accidents	19	12	22	16	13	16	20	15	11	10
Total accidents	91	119	127	117	127	114	103	90	148	130
Number of people involved										
Serious injuries	13	9	23	10	19	21	11	8	19	12
Fatalities	34	21	34	16	16	28	29	24	17	12
Rate of aircraft involved[14]										
Accidents per million departures	50.3	66.4	64.9	63.6	63.7	61.3	58.3	49.5	80	N/A
Fatal accidents per million departures	10.5	6.7	11.2	8.7	6.5	8.6	11.3	8.2	5.9	N/A
Accidents per million hours	80.2	98.4	101.2	93.3	101.8	95.3	93.3	78	124.9	N/A
Fatal accidents per million hours	16.7	9.9	17.5	12.8	10.4	13.4	18.1	13	9.3	N/A

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 matters, and what constitutes a reportable transport safety matter. Underreporting 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.

Flying training had the highest number of GA occurrences reported to the ATSB over the 10-year period. The number of private/business/sports aviation operations occurrences was about 90 per cent of those reported involving flying training. 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 GA.

The type of flying the aircraft was conducting was not reported to the ATSB for about 50 per cent of GA reported incidents. In these occurrences, someone other than the pilot(s) of the aircraft involved notified the ATSB (such as air traffic control, the public, pilots of nearby aircraft or aerodrome-base staff). A review of 'unknown' general aviation occurrences found that most were associated with either:

- runway events, primarily runway incursions
- bird and animal strikes
- communications failure or
- avionics/flight instruments.

The number of GA aircraft – per year – involved in incidents reported to the ATSB has decreased significantly since 2009. Further, the number of serious incidents in 2015 involving GA aircraft (113) was the lowest reported to the ATSB since 2009. In contrast, 2015 saw a high number of

[14] Foreign registered general aviation departures and hours are not known. VH- registered aircraft hours are used as a proxy denominator for all general aviation departures and hours. The real rate per departure or hour will be slightly smaller than the figures presented in this table.

accidents (130) compared with the 10-year average. However, the number of fatal accidents (10) and fatalities (12) in 2015 was the lowest over the reporting period.

Figure 14: General aviation occurrences and injuries (VH- and foreign registered aircraft), 2006 to 2015

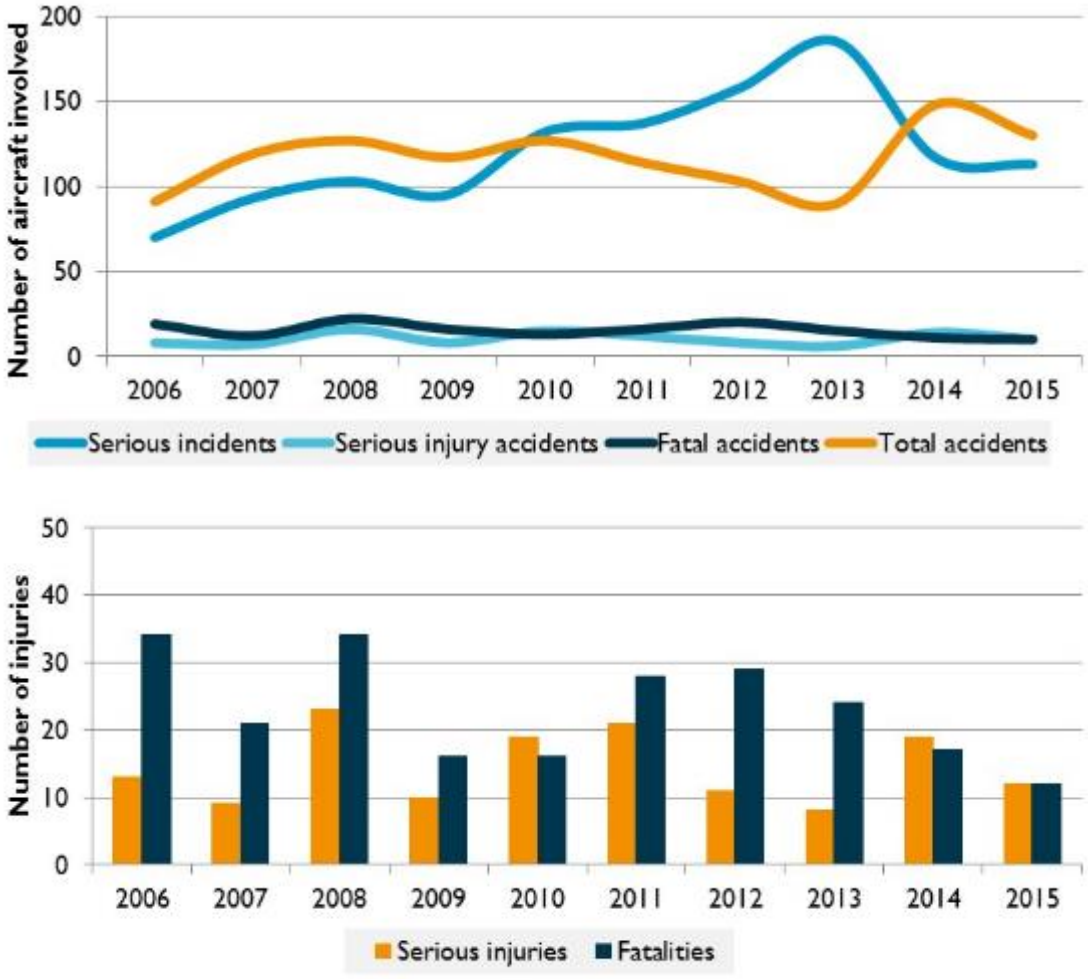
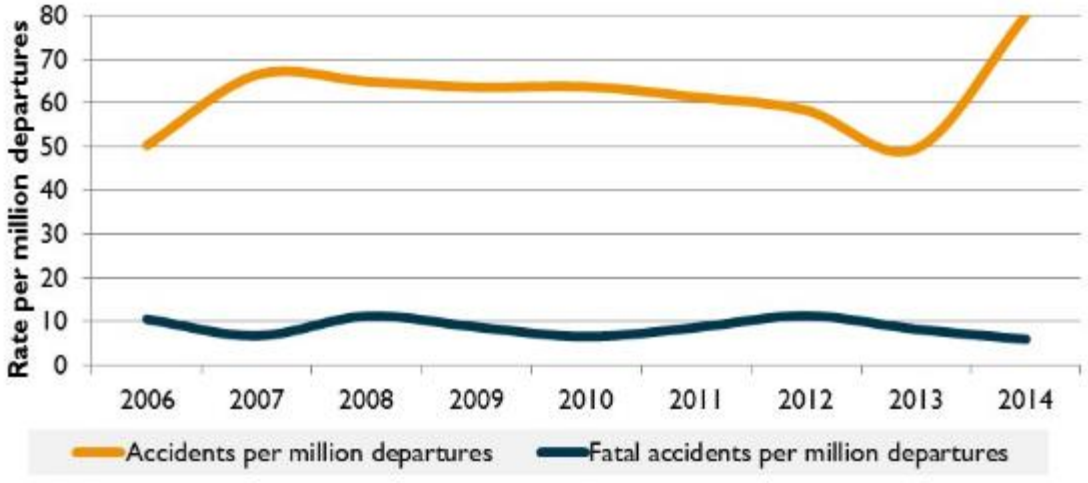


Figure 15: General aviation accident and fatal accident rate (per million departures, VH-registered aircraft only), 2006 to 2014



Of the 1,166 GA aircraft involved in accidents over the last 10 years, about 13 per cent (154) have been fatal, with 231 fatalities. In 2014 – the last year with available GA departure information – the GA accidents rate was four times that of commercial air transport. The year 2014 saw a highest

accident rate over the study period, however, the fatal accident rate was the lowest over the same period.

Accident types and severity varied 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 2006 to 2014 period, per million hours flown:

- Aerial agriculture had the highest average rates of reported accidents (151.2 per million hours flown) and fatal accidents (19.9 per million hours flown).
- Private/business/sports flying had the second highest average rates of accidents (112.8 per million hours flown) and fatal accidents (18.0 per million hours flown).
- Flying training had the lowest average rates of reported accidents (44.9 per million hours flown) and fatal accidents (1.8 per million hours flown).
- Aerial mustering had the second lowest, and survey and photography had the third lowest, average reported rates of accidents (58.5 and 71.1 per million hours flown) and fatal accidents (10.8 and 16.7 per million hours flown).

Aerial work

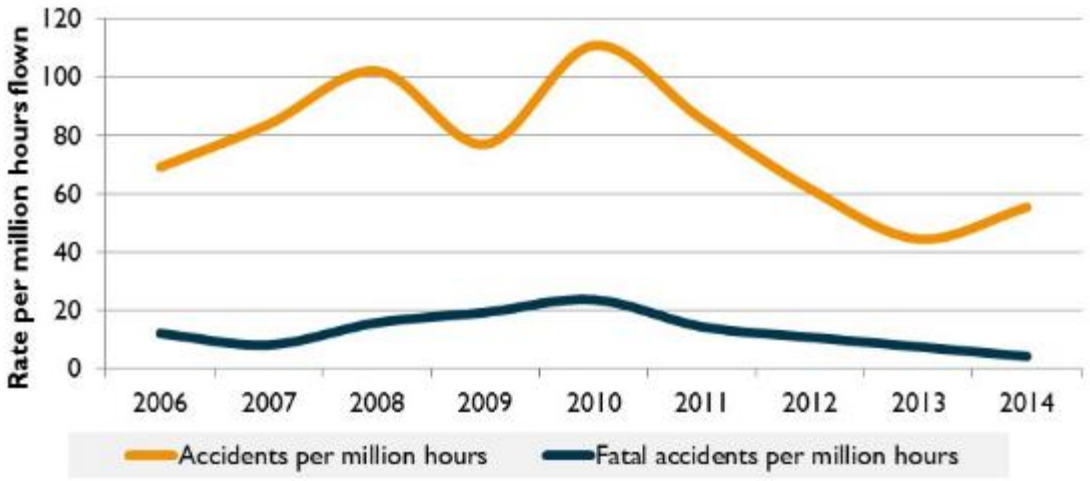
Aerial work is made up of a number of different commercial activities, including aerial agriculture, mustering, surveying and photography, search and rescue, and aerial fire control. Some of these activities require aircraft to regularly operate in conditions with inherent risks, such as manoeuvring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

In 2015, the number of incidents reported to the ATSB involving GA aircraft conducting aerial work was the greatest in the last 10 years. The number of aircraft involved in serious incidents (20) or accidents (39) was consistent with the 10-year average.

Table 11: Aerial work (VH- registered aircraft) occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	111	103	91	117	110	126	106	129	134	144
Serious incidents	9	12	13	13	28	23	31	44	18	20
Serious injury accidents	2	2	7	1	5	5	2	1	3	6
Fatal accidents	4	3	6	7	10	6	4	3	2	3
Total accidents	23	31	39	28	47	36	23	18	27	39
Number of people involved										
Serious injuries	2	2	9	2	6	8	2	1	3	6
Fatalities	9	3	7	7	12	9	4	3	3	3
Rate of aircraft involved										
Accidents per million hours	69.1	83.8	102.1	76.9	110.8	85.5	61.6	44.4	55.3	N/A
Fatal accidents per million hours	12	8.1	15.7	19.2	23.6	14.3	10.7	7.4	4.1	N/A

Figure 16: Accident rate for aircraft (VH- registered) involved in aerial work (per million hours flown), 2006 to 2014



The year 2014 had the lowest reported fatal accident rate and the second lowest accident rate in the years from 2006 (Figure 16).

The following sections explore the accidents, serious incidents and injuries that occurred in 2015 in the difference types of aerial work.

Aerial agriculture

The number of accidents, incidents and serious incidents involving aircraft conducting aerial agriculture (spraying and spreading activities) in 2015 were relatively consistent with the 10-year averages. Very few incidents (relative to serious incidents and accidents) were reported. There was one fatal accident in 2015.

The most commonly reported occurrence involving aircraft conducting aerial agriculture operations in 2015 was wirestrike (12) followed by forced or precautionary landing (9) and collision with terrain (7).

Table 12: Occurrences involving general aviation aircraft conducting aerial agriculture, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	1	4	5	5	2	7	6	9	7	7
Serious incidents	3	5	7	5	17	13	15	27	7	11
Serious injury accidents	1	1	4	0	0	3	0	0	1	0
Fatal accidents	1	0	3	3	4	1	2	1	0	1
Total accidents	8	10	18	10	16	18	10	8	12	17
Number of people involved										
Serious injuries	1	1	4	0	0	3	0	0	1	0
Fatalities	1	0	3	3	4	1	2	1	0	1
Rate of aircraft involved										
Accidents per million hours	129.6	161	230.2	136.5	154.2	179.3	112.3	100.2	157.6	N/A
Fatal accidents per million hours	16.2	0	38.4	40.9	38.5	10	22.5	12.5	0	N/A

There were 17 accidents – including one fatal – in 2015 involving aerial agriculture. Some of the notable accidents are described below:

- A Rockwell S-2R collided with a fence resulting in substantial damage to the aircraft following a runway excursion at Cobden, Vic (ATSB occurrence 201500601).
- An Air Tractor AT-502B sustained substantial damage to the left wing and propeller following a collision with a pole. The pilot was able to continue flying the aircraft and decided to return to Dalby, Qld, first electing to spray around 500 L of the chemical in order to reduce the load prior to landing. The aircraft landed without further incident although aircraft vibrations were observed (ATSB investigation AO-2015-142).

Collision with a pole involving an Air Tractor AT-502B near Dalby, QLD on 4 December 2015. Source: Aircraft operator.

- A Robinson R44, conducting aerial spraying operations near Marion Bay, SA, struck an unidentified powerline severing the tail rotor blade tips. The helicopter landed safely and the occupants were not injured (ASTB investigation AO-2015-037). There were four more wirestrike accidents – including another investigated (ATSB investigation AO-2015-087) – involving aircraft conducting aerial agriculture operations reported to the ATSB in 2015.
- The propeller of a Flethcher FU-24 collided with the right wing tip and tail of a Gippsland GA-200 – both on landing – near Cootamundra Aerodrome, NSW. The pilots of both aircraft were not injured (ATSB investigation AO-2015-023).

Right wing tip of a Fletcher FU-24 following a collision with a Gippsland GA-200 near Cootamudra, NSW on 27 February 2015. Source: Aircraft owner.

- An Air Tractor 502B – conducting aerial spraying – sustained minor damage after striking a Toyota Hilux driving on the property being sprayed, near Hay, NSW. The driver of the Hilux sustained minor injuries and the pilot was not injured (ATSB investigation AO-2015-111).

Rear and front views showing damage to the Hilux headboard following a collision with an Air Tractor AT-502B near Hay, NSW on 17 September 2015. Source: Agricultural company.

- The pilot of a Grumman G164 sustained minor injuries from a collision with terrain following a loss of control shortly after take-off near Tharwa, ACT. The aircraft was substantially damaged (ATSB investigation AO-2015-092).

Collision with terrain of a Grumman G-164B following a loss of control near Tharwa, ACT on 6 August 2015. Source: Pilot.

- The pilot of a Piper PA-25 was fatally injured from a collision with terrain during an insect baiting operation on a farming property near Darlington VIC. The ATSB investigation is continuing (ATSB investigation AO-2015-030).

Collision with terrain of a Piper PA-25 near Darlington, VIC on 20 March 2015. Source: ATSB.

Aerial mustering

Similar to aerial agriculture, the number of aerial mustering incidents reported to the ATSB each year, relative to the number of accidents and serious incidents is low. There have been no safety incidents (excluding serious incidents) reported to the ATSB involving aerial mustering aircraft since 2011.

The most commonly reported occurrence involving aerial mustering aircraft in 2015 was collision with terrain.

Table 13: Occurrences involving general aviation aircraft conducting aerial mustering, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	0	1	0	2	0	1	0	0	0	0
Serious incidents	1	0	1	0	2	1	0	2	2	0
Serious injury accidents	0	1	1	0	4	1	1	0	2	3
Fatal accidents	0	1	0	3	4	1	2	0	0	2
Total accidents	4	9	3	6	19	6	9	1	4	11
Number of people involved										
Serious injuries	0	1	1	0	4	1	1	0	2	3
Fatalities	0	1	0	3	5	1	2	0	0	2
Rate of aircraft involved										
Accidents per million hours	39	79.8	26.6	56.8	160.9	47.7	80	8	27.7	N/A
Fatal accidents per million hours	0	8.9	0	28.4	33.9	7.9	17.8	0	0	N/A

In 2015, there were 11 aerial mustering aircraft accidents reported to the ATSB. Two of the accidents were fatal. Some of the notable accidents are described below:

- The pilot of a Robinson R22 was seriously injured from a collision with terrain near Minnamoolka, Qld. The accident occurred when clothing blew out the door and wrapped around the tail rotor. The helicopter was destroyed (ATSB occurrence 201503150).
- A passenger sustained serious injuries after approaching from behind the helicopter – a Robinson R22 – and being struck by the tail rotor at Carisbrooke Station, Qld (ATSB occurrence 201506158).
- The pilot of a Robinson R22 was seriously injured when the helicopter collided with terrain at Kiana Station (NT). The helicopter was substantially damaged (ATSB investigation AO-2015-134).
- A Robinson R22 was substantially damaged from a collision with terrain following a loss of control near Roma, Qld. While moving cattle, the helicopter was turned downwind with a high power setting and low forward speed. The pilot detected a high rate of descent and attempted to fly out of the situation but had insufficient forward speed and low rotor rpm. The helicopter sank quickly and collided with the ground. The tail of the helicopter was chopped off by the main rotor during the collision sequence. The pilot was not injured in the accident (ATSB investigation AO-2015-009).

Collision with terrain of Robinson R22 near Roma, QLD on 16 January 2015. Source: Operator.

- A Robinson R22 was substantially damaged when the helicopter collided with terrain near Kalbarri, WA. Prior to the accident, the pilot and passenger exited the helicopter without shutting down the engine. Several minutes later the aircraft lifted of the ground 3-4 m before descending and striking the ground tail first. The passenger and pilot were not injured (ATSB investigation AO-2015-017).

Collision with terrain of Robinson R22 near Kalibarri, WA on 11 February 2015. Source: Pilot.

- The pilot of a Robinson R44 sustained minor injuries from a collision with terrain while conducting aerial mustering in conditions where there was a high probability of serious carburettor icing,130 km east of Alice Springs, NT (ATSB investigation AO-2015-077).
- The pilot of a Robinson R22 was fatally injured when the helicopter collided with terrain following the tail rotor striking a tree near Mitchell, Qld. Given the conditions at the time of the accident – setting sun and darkened backdrop, it is likely that these conditions affected the pilot's vision and perception, and therefore ability to identify the isolated tree, contributing to the accident. (ATSB investigation AO-2015-055).

Collision with terrain of Robinson R22 near Mitchell, QLD on 28 May 2015. Source: ATSB.

- The pilot of a Robinson R44 was fatally injured when the helicopter collided with terrain 154 km south-west of Timber Creek (NT). After refuelling from drum fuel supply, the helicopter took off and, a short time later, experienced a loss of engine power at low altitude. The loss of engine power was a result of fuel starvation due to contaminants introduced into the helicopter's fuel system during the drum refuelling. The loss of engine power required the pilot to conduct an autorotation and forced landing. For reasons that could not be determined, the pilot was unable to satisfactorily reduce the rate of descent before the helicopter impacted the ground heavily. The pilot survived the impact but later succumbed to their injuries. The helicopter was destroyed (ATSB investigation AO-2015-062).

Search and rescue

The year 2015 had the lowest number of reported incidents involving aircraft conducting search and rescue operations in the previous 4 years.

Generally, the ATSB is notified of very few occurrences involving search and rescue aircraft. This is likely due to the very small amount of search and rescue flying in Australia (relative to other type of general aviation).

Table 14: Occurrences involving general aviation aircraft conducting search and rescue operations, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	11	7	3	4	4	7	7	9	12	5
Serious incidents	0	0	1	0	3	0	3	2	1	0
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	0	1	0	1	0	0
Total accidents	0	0	0	0	0	1	0	1	1	0
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	0	1	0	1	0	0

In 2015, there were no accidents or serious incidents involving search and rescue aircraft reported to the ATSB.

Fire control

Generally, few accidents and serious incidents involving fire control operations are reported to the ATSB each year, despite the potential hazards associated with reduced visibility, spatial disorientation, low-level manoeuvring, and high operating weight.

There were three incidents reported to the ATSB in 2015, all involving runway incursions.

Table 15: Occurrences involving general aviation aircraft conducting fire control operations, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	6	3	1	6	1	0	3	3	4	3
Serious incidents	1	1	1	3	0	0	1	1	1	1
Serious injury accidents	0	0	0	1	0	0	0	0	0	0
Fatal accidents	1	0	0	1	0	0	0	1	0	0
Total accidents	3	1	0	4	0	0	0	2	2	1
Number of people involved										
Serious injuries	0	0	0	2	0	0	0	0	0	0
Fatalities	1	0	0	1	0	0	0	1	0	0

In 2015, there was one accident and one serious incident involving aerial fire control aircraft reported to the ATSB. These are described below:

- A Robinson R44 was substantially damaged from a collision with terrain when the aircraft made a forced landing following a bird strike near Emu Springs, NT. The pilot was not injured in the accident (ATSB occurrence 201504814).
- A Eurocopter AS 350 was substantially damaged when the tail rotor struck the Bambi bucket used for fire control during refuelling at Glenbrook helipad, NSW. The pilot and crewperson were not injured (ATSB investigation AO-2015-147).

Bambi bucket and damaged tail rotor of a Eurocopter AS 350 tail at Glenbrook Helipad, NSW on 19 December 2015. Source: sei.ind.com and Helicopter operator.

Survey and photography

Survey and photography aerial work results in around the same number of fatalities per year as aerial agriculture and mustering. However, survey and photography has a much higher rate of reporting occurrences – the highest for any form of aerial work. This is probably an indication of a stronger reporting culture (relative to other types of aerial work).

The most commonly reported incident for survey and photography operations in 2015 to the ATSB was birdstrike followed by engine failure or malfunction.

Table 16: Occurrences involving general aviation aircraft conducting survey and photography operations, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	11	15	17	24	29	27	17	26	27	36
Serious incidents	1	1	1	2	3	3	7	4	2	2
Serious injury accidents	1	0	1	0	1	0	0	0	0	1
Fatal accidents	2	1	2	0	0	2	0	0	1	0
Total accidents	3	4	8	3	5	4	0	5	2	1
Number of people involved										
Serious injuries	1	0	3	0	2	1	0	0	0	1
Fatalities	7	1	2	0	0	4	0	0	2	0
Rate of aircraft involved										
Accidents per million hours	67	73.8	124.2	78.2	85.5	58.7	0	99.3	53.1	N/A
Fatal accidents per million hours	44.7	18.4	31	0	0	29.4	0	0	26.5	N/A

In 2015, there was one accident and two serious incidents involving survey and photography aircraft investigated by the ATSB. These are described below:

- The pilot was seriously injured and three passengers sustained minor injuries from a collision with terrain of an Aerospatiale AS 350 at Whyanbeel Valley, Qld. The accident occurred when the pilot was forced to make an autorotation landing due to engine failure. The ATSB investigation in continuing (ATSB investigation AO-2015-124).

Collision with terrain following a forced landing of an Aerospatiale AS 350 at Whyanbeel Valley, QLD on 2 November 2015. Source: ATSB.

- During cruise, the crew of a Eurocopter AS 350 observed another unknown aircraft overtaking in close proximity – leading to a near collision – near Sea World, Qld (ATSB occurrence 201506334).
- The crew of a McDonnell Douglas 500 Helicopter observed a Cessna 182 approaching at a similar altitude – leading to a near collision. The pilot took avoiding action. The crews of both aircraft transmitted their intentions on the CTAF but neither heard any previous calls from the other aircraft (ATSB occurrence 201501979).

Flying training

The year 2015 saw the highest number of incidents involving flying training in the last 10 years. The number of serious incidents was consistent with the 10-year average. However, both 2014 and 2015 had considerably more accidents (31 and 23 respectively) than the previous four years (averaging 15 per year).

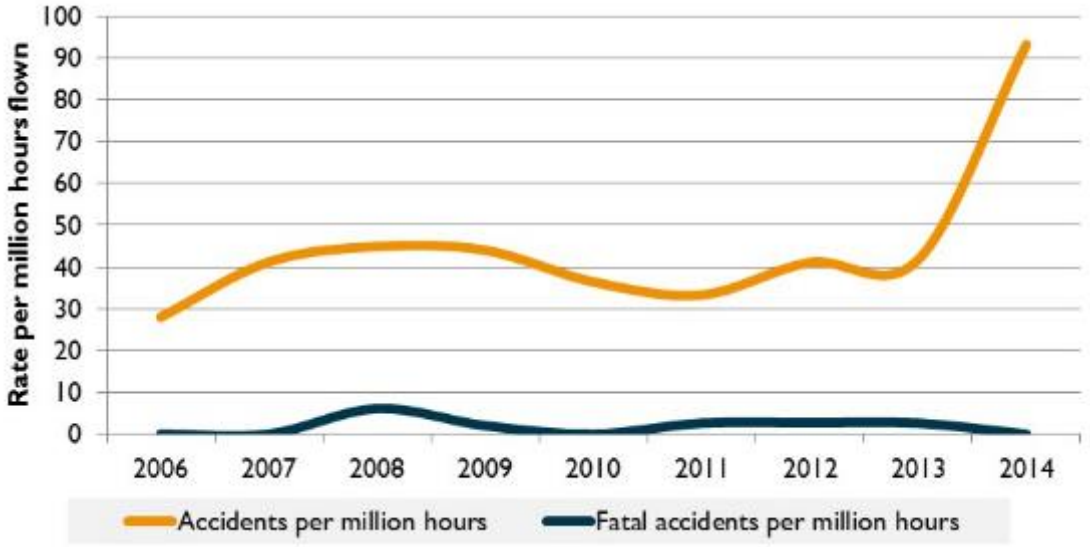
In 2014, the flying training accident rate was more than double that of any year in the previous eight.

The most common reported occurrences involving flying training in 2015 involved aircraft separation issues and birdstrikes. Near collision was the most commonly reported accident or serious incident.

Table 17: Flying training (VH- registered) aircraft occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	295	265	210	226	213	210	222	296	288	377
Serious incidents	22	18	18	24	30	22	45	48	42	30
Serious injury accidents	1	0	0	1	2	0	1	0	2	1
Fatal accidents	0	0	3	1	0	1	1	1	0	1
Total accidents	12	19	22	22	16	13	15	16	31	23
Number of people involved										
Serious injuries	1	0	0	1	3	1	1	0	2	1
Fatalities	0	0	4	1	0	2	2	1	0	1
Rate of aircraft involved										
Accidents per million hours	28	41.2	44.9	44	36.4	33.3	41.1	41.7	93.2	N/A
Fatal accidents per million hours	0	0	6.1	2	0	2.6	2.7	2.6	0	N/A

Figure 17: Accident rate for aircraft (VH- registered) involved in flying training (per million hours flown), 2006 to 2014



In 2015, there were 23 accidents involving flying training. Some of the notable accidents are described below:

- A Liberty Aerospace XL-2 was substantially damaged from a hard landing at Camden airport, NSW (ATSB occurrence 201501307).
- A Liberty Aerospace XL-2 was substantially damaged when the aircraft collided with two fences and trees following a forced landing near Camden airport, NSW. While experiencing control issues, the training pilot handed control of the aircraft to the instructor who decided to make a forced landing in a nearby paddock (ATSB investigation AO-2015-125).

Collision with terrain following a forced landing of an Aerospace XL-2 near Camden airport, NSW on 29 October 2015. Source: Insurance assessor.

- During approach at Jandakot Aerodrome, WA, the pilot of a Cessna R182 failed to lower the landing gear resulting in a wheels up landing and substantial damage to the aircraft (ATSB occurrence 201503645).
- During a crosswind landing at Kadina, SA, the tail of a Diamond Aircraft DA 40 struck the ground resulting in substantial damage to the aircraft (ATSB occurrence 201500077).
- A Piper PA28, conducting a solo training flight at Moorabbin Aerodrome, Vic, collided with another aircraft resulting in minor injuries to that aircraft's three passengers and pilot. The pilot of the Piper conducted a forced landing following a loss of power from the aircraft's engine. The aircraft landed around one-third of distance along the runway and did not decelerate normally. The pilot accessed that the aircraft was not going to be able to stop prior to the end of the sealed runway but would have a suitable grass overshoot area beyond the runway. The Piper's left wing struck the tail of another aircraft waiting on the taxiway, causing substantial damage to both aircraft. The pilot of the Piper was not injured (ATSB investigation AO-2015-036).

Collision between a Cessna 172 and a Piper PA 28 at Moorabbin Aerodrome, VIC on 11 April 2015. Source: Aircraft operator.

- The student and instructor of a Robinson R22 sustained minor injuries when the helicopter collided with terrain during a training flight at Archerfield Aerodrome, Qld. The flight included a demonstration of how to manage a jammed pedal condition, which was simulated by holding the pedals in a set position with foot pressure. As part of the demonstration, the instructor conducted a simulated jammed-pedal run-on landing on a grass surface outside the defined runway strips, near the northern boundary of the airport. When the helicopter touched down, it bounced slightly, and yawed to the left, while still travelling forward at about 10 to 15 kt. The instructor discontinued the demonstration following the bounce, but was unable to correct the yaw before the helicopter touched down again. When the helicopter touched down a second time after a short bounce, the forward part of the right skid dug into a surface undulation. The right skid then effectively acted as a pivot, tipping the helicopter onto its right side causing substantial damage to the aircraft (ATSB investigation AO-2015-025).
- The pilot of a Robinson R44 sustained minor injuries when the helicopter collided with terrain at Darwin Aerodrome. Earlier in the day, the chief pilot had conducted an acceptance flight with the pilot. During the engine start, the helicopter began to yaw to the left. The pilot quickly checked that the pedals were neutral and put some 'weight' on the collective to confirm that it was fully down. However, the helicopter continued to yaw left rapidly through about 90°. The pilot applied full right pedal, but the helicopter did not respond and continued the yaw through about 180°, before falling onto its right side and being substantially damaged. (ATSB investigation AO-2015-117).

Collision with terrain of a Robinson R44 at Darwin Aerodrome, NT on 7 October 2015. Source: Aircraft operator.

- A student pilot and instructor of a Victa Airtourer 115 sustained minor injuries from a collision with terrain at Leongatha Aerodrome, Vic. The student pilot was flying the first circuit for crosswind circuit training. The instructor reported that the circuit was normal and the approach was stable up to about 100 ft above ground level when the student put the final stage of flap out. As the aircraft flared to land on the runway, a strong gust of wind blew the aircraft off the runway centreline to the left and the aircraft bounced hard. The student initiated a go-around, applying full power, with the aircraft still drifting further to the left. As the aircraft was not climbing, the instructor called 'taking over' and the student handed over control of the aircraft. The instructor lowered the nose of the aircraft to gain airspeed. The aircraft continued to drift further away from the runway centreline. The student noticed the flaps were in the down position and thinking that it would assist, and without checking with the instructor, retracted the flaps to the up position. The aircraft descended and about 100 m past the threshold of the runway, the aircraft collided with the airport perimeter fence. After a further 20 m, the aircraft flipped over the fence and came to rest upside down. The instructor and student exited the aircraft quickly through the broken canopy, as fuel was gushing from the fuel tanks. The aircraft was substantially damaged (ATSB investigation AO-2015-057).

Collision with terrain of a Victa Airtourer 115 at Leongatha Aerodrome, VIC on 29 May 2015. Source: Aircraft operator.

- The student pilot of a Robinson R22 sustained minor injuries from a collision with terrain at Orange Aerodrome, NSW. An instructor and student were conducting an in-ground-effect hover lesson. The lesson had covered the individual effect and use of pedals, the collective and the cyclic. After each instructor demonstration, the student spent time practicing the sequence. In the last few minutes of the lesson, the student again practiced using the cyclic in a hover at about 3 ft above ground level, while the instructor maintained a light control on the collective and the pedals. The helicopter began to roll to the right and move rearwards. The student reacted quickly, but firmly moved the cyclic further backward and to the right which resulted in an increased rearward speed. The instructor attempted to regain control and lifted the collective a small amount; but before control could be regained, the right skid struck the ground and the helicopter rolled further right and struck the ground. The student and instructor exited the helicopter and moved away to a safe distance. The helicopter was substantially damaged (ATSB investigation AO-2015-016).
- The pilot of a Cessna 172 – conducting a solo navigation flight – was fatally injured when the aircraft collided with terrain near Millbrook, Vic. The aircraft was destroyed in the accident. The investigation in continuing (ATSB investigation AO-2015-105).

Accident site, showing the initial point of contact and wreckage trail of a Cessna 172 near Millbrook, VIC on 8 September 2015. Source: ATSB.

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. 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.

Private/business and sports aviation operations have the greatest number of reported accidents (65) of any GA operation type in 2015. However, this operation types had the equal second lowest number of fatalities (8 from 6 accidents) in the last 10 years.

In 2014, the accident rate – per hour flown – for private/business and sports aviation was significantly higher than for any of the previous nine years.

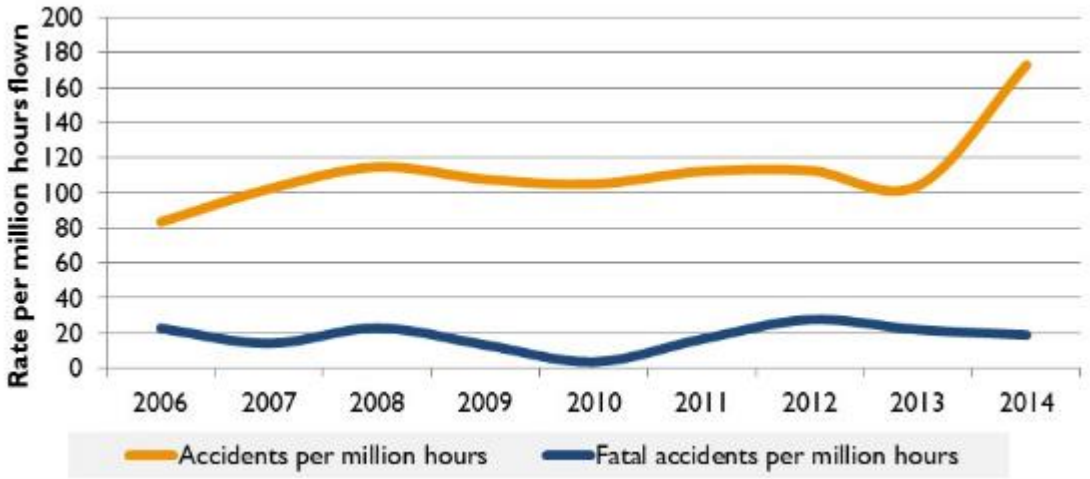
The most common occurrences reported to the ATSB in 2015 concerning private/business and sports aircraft were engine failure or malfunction, landing gear/indication and collision with terrain. The most common accidents were collision with terrain, and the most common serious incidents were near collisions and engine failure or malfunction.

The number of occurrences in the private/business operation type is significantly greater than those of sports aviation.

Table 18: Private/business/sports aviation (VH-registered) aircraft occurrences (including gliding), 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	205	212	185	201	160	191	168	136	187	172
Serious incidents	15	24	17	21	21	38	43	45	28	35
Serious injury accidents	5	5	9	6	8	7	3	4	9	3
Fatal accidents	15	9	13	8	2	9	15	11	9	6
Total accidents	55	65	65	65	59	61	61	52	82	65
Number of people involved										
Serious injuries	10	7	14	7	10	12	6	6	14	5
Fatalities	25	18	23	8	3	17	23	20	14	8
Rate of aircraft involved										
Accidents per million hours	83.4	102.3	114.7	107.7	105.0	112.2	112.8	104.1	172.8	N/A
Fatal accidents per million hours	22.7	14.2	22.9	13.3	3.6	16.6	27.7	22.0	19.0	N/A

Figure 18: Accident rate for aircraft (VH- registered) involved in private/business/sport (including gliding) (per million hours flown), 2006 to 2014



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. The number of incidents reported to the ATSB in 2015 (149) was consistent with the 10-yearly average of around 160 per year. The number of accidents and serious incidents were also consistent with their 10-year averages; however, fatalities were significantly less than average.

Table 19: Occurrences involving general aviation aircraft conducting private and business operations, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	193	196	162	184	135	165	146	117	163	149
Serious incidents	14	19	14	17	14	27	34	28	22	28
Serious injury accidents	4	4	7	3	5	4	1	3	7	3
Fatal accidents	12	7	11	5	2	8	12	10	8	5
Total accidents	48	57	58	56	52	43	47	43	69	56
Number of people involved										
Serious injuries	9	6	12	3	6	9	3	4	12	5
Fatalities	21	15	20	5	3	16	19	19	13	7

There were 56 VH- registered aircraft conducting private and/or business operations involved in accidents in 2015. There were seven fatalities from five fatal accidents, and three accidents resulted in serious injuries. The fatal accidents are described below:

- The pilot of an amateur-built Pitts model 12 was fatally injured from a collision with terrain near Maitland Aerodrome, NSW. Witnesses reported hearing a loud engine noise – prior to the accident – and then observed the aircraft at the top of what appeared to be a vertical climb. The aircraft slid backwards, tail first, before entering a horizontal spin. The aircraft was destroyed by impact forces and an intense post-impact fire (ATSB investigation AO-2015-074).

Accident site, showing collision with terrain of an amateur-built Pitts model 12 near Maitland Aerodrome, NSW on 8 July 2015. Source: ATSB.

- The pilot of a Cessna 310 was fatally injured from a collision with terrain near Mildura Aerodrome, Vic. During the flight from Moorabbin Aerodrome, Vic to Mildura, the pilot reported experiencing control issue to air traffic control. Shortly after, the pilot communicated that control had been restored and continued onto Mildura. A fire commenced following the impact with the

ground and the aircraft was destroyed. The ATSB investigation is continuing (ATSB investigation AO-2015-129).

- A passenger was fatally injured and the pilot sustained serious injuries when an amateur-built Stoddard Hamilton Glasair SH-2FT collided with terrain near Wedderburn Airport, NSW. Witnesses stated that they heard the aircraft's engine surge twice and then silence, prior to hearing the aircraft collide with wooded terrain about 900 m north of the runway threshold. The ATSB found that during the turn onto final approach to land, the aeroplane's engine ceased operating. Following the loss of power, the pilot was unable to control the aircraft's descent to an appropriate forced landing area before colliding with the ground. The ATSB also found that the loss of power was probably due to carburettor icing. (ATSB investigation AO-2015-079).

Accident site, showing collision with terrain of an amateur-built Stoddard Hamilton Glasair SH-2FT near Wedderburn Airport, NSW on 19 July 2015. Source: ATSB.

- During cruise, a Eurocopter EC 135 T1 collided with terrain near Cooranbong, NSW resulting in fatal injuries to two passengers and the pilot. The helicopter was destroyed in the accident. The ATSB investigation in continuing (ATSB investigation AO-2015-131).
- The pilot of an amateur-built Cicaré CH-7Bt was fatally injured when the aircraft collided with terrain following an in-flight break-up near Roy Hill Station, WA. The ATSB examined the helicopter wreckage and identified that the stabiliser had separated in-flight from the tail boom as a result of fatigue cracking of the stabiliser mount. The investigation is continuing (ATSB investigation AO-2015-089). A similar fatal accident involving in-flight stabiliser separation on a Cicaré CH-7B series helicopter was also investigated by the ATSB (ATSB investigation AO-2014-086).

Sports aviation

Sports aviation includes gliding, parachute operations, private balloon operations and aerobatics in VH-registered aircraft. In 2015, there were 23 aircraft involved in incidents, which was slightly higher than the 10-year average. The number of accidents was consistent with the 10-year average.

Table 20: Occurrences involving general aviation aircraft conducting sports aviation, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	12	16	23	17	25	26	22	19	24	23
Serious incidents	1	5	3	4	7	11	9	17	6	7
Serious injury accidents	1	1	2	3	3	3	2	1	2	0
Fatal accidents	3	2	2	3	0	1	3	1	1	1
Total accidents	7	8	7	9	7	18	14	9	13	9
Number of people involved										
Serious injuries	1	1	2	4	4	3	3	2	2	0
Fatalities	4	3	3	3	0	1	4	1	1	1

There were nine accidents – including one fatal, seven serious incidents and no serious injury incidents in 2015. Some of these are summarised below:

- During taxi at Shute Harbour, Qld, a Cessna 208 sustained minor damage from a collision with a parked aircraft. Engineers detected a fractured brake line (ATSB occurrence 201506154).
- During approach at Charters Towers Aerodrome, Qld, an Alexander Schleicher Segelflugzeugbau K7 glider landed short of the runway and collided with a tree. The pilot sustained minor injuries and aircraft was substantially damaged (ATSB occurrence 201501054). There were another three similar accidents – where a glider collided with terrain on landing and the pilots sustained minor injuries – reported to the ATSB in 2015.
- The pilot of a Schempp-Hirth Flugzeugbau GmbH NIMBUS 2 glider was fatally injured from a collision with terrain near Benalla Aerodrome, Vic. The aircraft was substantially damaged. The ATSB provided technical assistance to the Gliding Federation of Australia during their investigation (ATSB investigation AE-2015-005).

Foreign general aviation

Generally, there are a small number of foreign GA accidents and serious incidents each year. In 2015 there were 19 foreign GA aircraft incidents reported to the ATSB. This is consistent with the 10-year average.

Table 21: Foreign registered general aviation aircraft occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	14	18	26	14	12	14	18	16	25	19
Serious incidents	0	1	0	0	1	0	0	3	0	2
Serious injury accidents	0	0	0	0	0	0	2	0	0	0
Fatal accidents	0	0	0	0	1	0	0	0	0	0
Total accidents	1	1	1	0	2	0	2	0	2	1
Number of people involved										
Serious injuries	0	0	0	0	0	0	2	0	0	0
Fatalities	0	0	0	0	1	0	0	0	0	0

There was one accident reported to the ATSB in 2015. This is described below:

- A Schempp-Hirth Flugzeugbau GmbH Ventus 2CT was substantially damaged and the pilot sustained minor injuries when the aircraft collided with a fence following failure of the engine to start near Merton, Vic (ATSB occurrence 201500116).

Other general aviation

Between 2006 and 2015, over 7,100 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 over 50 per cent over the last 6 years, due to improvements in reporting detail and data collection methods. The year 2015 had the lowest number of 'unknown' GA occurrences in the last 10 years. 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 have 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.

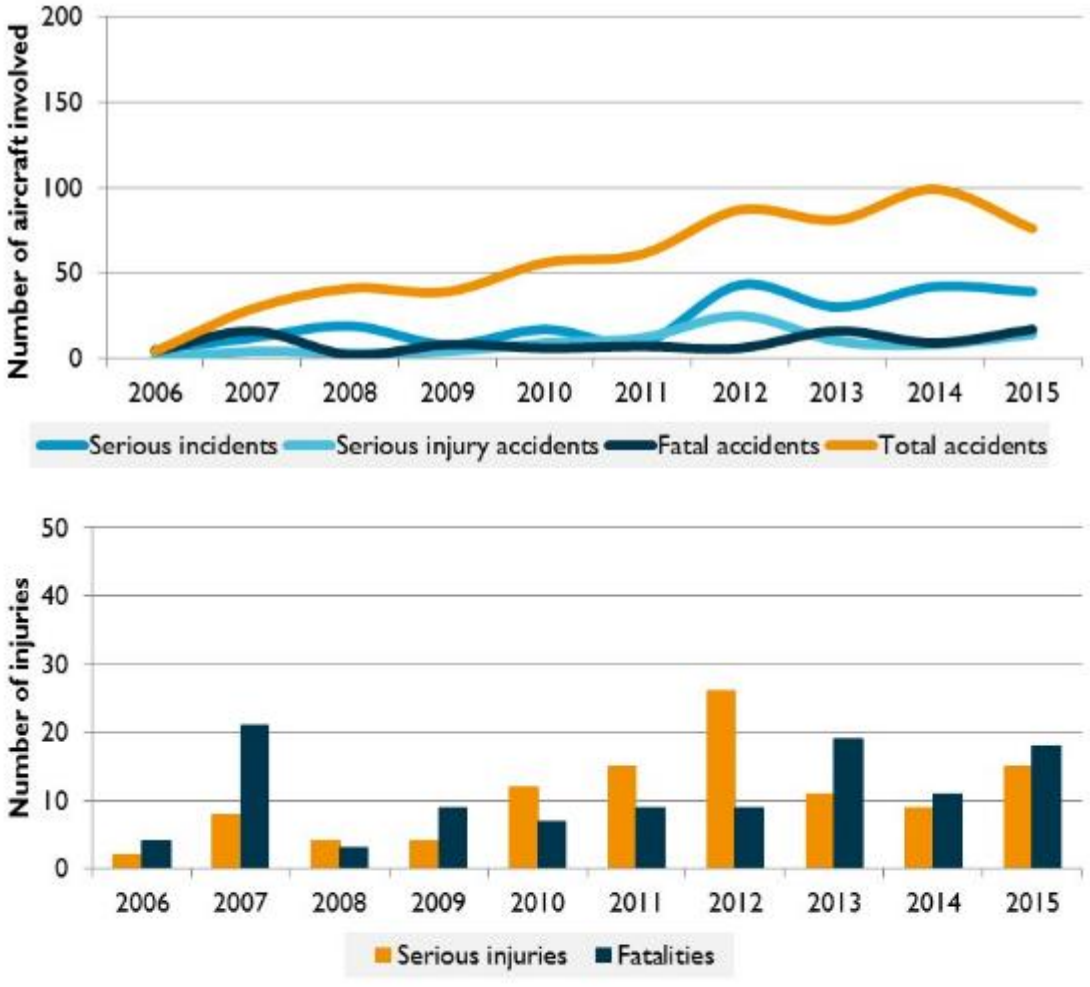
In 2015, the number of incidents, serious incidents and accidents involving recreational aircraft reported to the ATSB was consistent with the previous four years. However, the number of fatal accidents was the greatest in the study period (17). Accidents involving recreational aircraft are not usually investigated by the ATSB, but the RAAO may conduct its own investigation.

Table 22: Recreational aviation (non-VH registered) aircraft occurrences, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	12	48	66	44	72	88	113	114	139	91
Serious incidents	5	12	19	8	17	9	43	30	42	39
Serious injury accidents	0	4	3	4	9	12	25	10	8	14
Fatal accidents	4	16	2	8	6	7	6	16	9	17
Total accidents	4	29	41	39	56	61	87	81	99	76
Number of people involved										
Serious injuries	2	8	4	4	12	15	26	11	9	15
Fatalities	4	21	3	9	7	9	9	19	11	18
Rate of aircraft involved[15]										
Accidents per million hours	16.2	112.0	145.7	125.3	195.2	203.0	247.0	245.7	351.9	N/A
Fatal accidents per million hours	16.2	61.8	7.1	25.7	20.9	23.3	17.0	48.5	32.0	N/A

There were 17 fatal accidents involving recreational aircraft in 2015 resulting in 18 fatalities, and a further 14 accidents where the occupants were seriously injured.

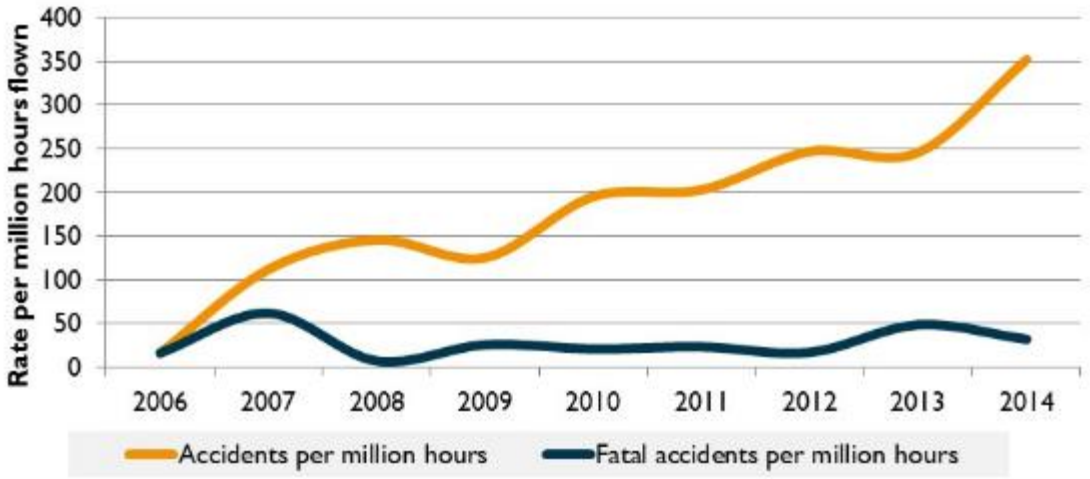
Figure 19: Recreational aviation occurrences and injuries, 2006 to 2015



[15] Data was only available from 2006 to 2014.

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 to the ATSB, the recreational aviation accidents in 2014 (351.9 accidents per million hours flown) was higher than any other type of flying in Australia. Recreational aeroplanes (those aircraft registered with Recreational Aviation Australia (RAAus)) made up the largest proportion of recreational flying hours, and were also involved in around 71 per cent of all recreational aviation accidents in the 2006 to 2015 period, and 48 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.

Figure 20: Recreational aviation accident and fatal accident rate (per million hours flown), 2006 to 2014



The fatal and serious injury accidents involving recreational aircraft in 2015 are described in the sections below. For many of these occurrences, limited 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 84 recreational aircraft involved in accidents or serious incidents reported to the ATSB in 2015 that did not result in fatal or serious injuries. Most of these occurrences involved fixed-wing recreational aeroplanes, with six involving weight shift aircraft and three gyrocopters. The common occurrence types were:

- collision with terrain
- engine failure or malfunction
- hard landing
- loss of control
- ground strike
- runway excursion.

Gyrocopters

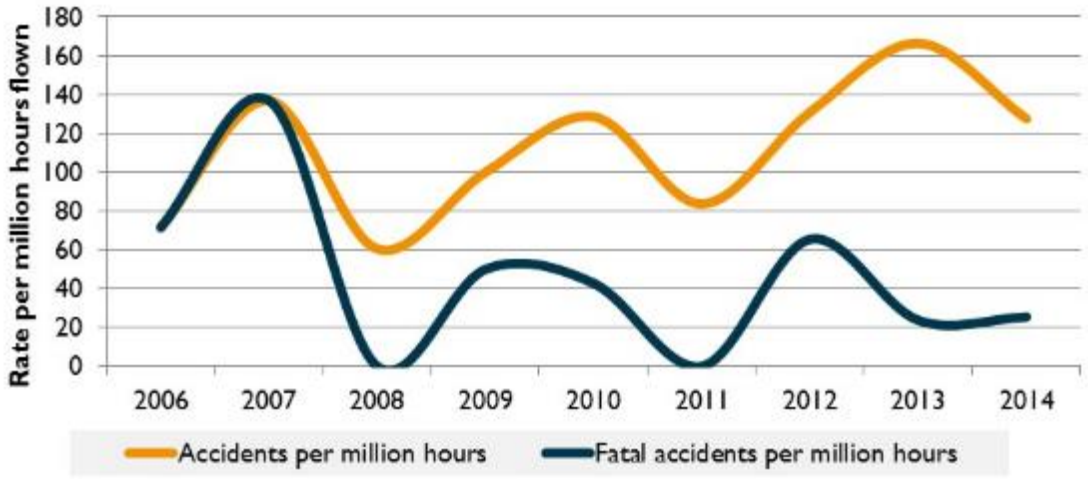
Over the last 10 years, eight incidents, six serious incidents and 44 accidents have been reported to the ATSB involving gyrocopters. While incident reporting rates have been very low over this period, there was a notable increase in reporting of gyrocopter accidents registered with the Australian Sport Rotorcraft Association (ASRA) from 2006. Figure 21 shows the rate of accidents and fatal accidents involving gyrocopters over the 2006 to 2015 period (for which flying hours were available).There was a 40 per cent increase in flying activity over this period. On average, gyrocopters had an accident rate (112 accidents per million hours flown) that was similar to

private/business/sports (including gliding). On the other hand, gyrocopter operations had the highest fatal accident rate of all types of flying in most years (46 per million hours flown, about double that of VH-registered private/business/sport operations and recreational weight shift and aeroplane operations).

Table 23: Occurrences involving recreational gyrocopter operations, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	0	1	1	0	1	0	0	3	1	1
Serious incidents	0	0	2	0	0	1	1	1	0	1
Serious injury accidents	0	0	0	0	2	3	1	2	1	0
Fatal accidents	2	4	0	2	2	0	3	1	1	2
Total accidents	2	4	2	4	6	4	6	7	5	4
Number of people involved										
Serious injuries	1	3	0	0	2	3	2	2	1	1
Fatalities	2	4	0	2	2	0	4	2	1	2
Rate of aircraft involved										
Accidents per million hours	71.6	136.8	60.5	99.9	128.5	83.6	130.9	166.3	127.5	N/A
Fatal accidents per million hours	71.6	136.8	0.0	50.0	42.8	0.0	65.4	23.8	25.5	N/A

Figure 21: Accident rate for recreational gyrocopter operations (per million hours flown), 2006 to 2014



There were four accidents – including two fatal – reported to the ATSB in 2015 involving gyrocopters. The fatal accidents are described below:

- During mustering operations, the pilot of a Sportscopter Vortex was fatally injured from a collision with terrain after striking a tree near Charleville Aerodrome, Qld (ATSB occurrence 201504894).
- The pilot of an AutoGyro Cavalon was fatally injured and a passenger sustained serious injuries when the gyrocopter collided with powerlines and subsequently collided with water near Frankston, Vic (ATSB occurrence 201503566).

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 RAAus. Reporting of safety occurrences involving recreational aeroplanes has increased significantly in recent years, as shown in Table 24.

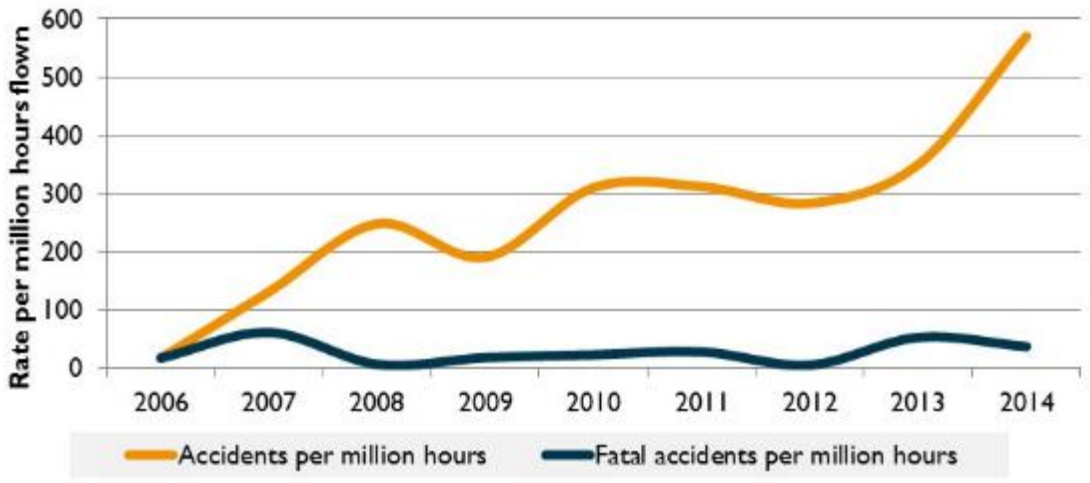
Figure 22 shows the rate of accidents and fatal accidents involving recreational aeroplanes over the 2006 to 2014 period. Despite the increase in flying activity, the accident rate has increased steadily over the study period. In 2014, the recreational aeroplane accident rate in Australia (about 570 per million hours flown) was significantly higher than for any other type of flying, including higher risk GA operations such as aerial agriculture (158 accidents per million hours flown) and (VH-registered) private/business/sport (including gliding) (173 accidents per million hours flown). The number of accidents in 2015 was significantly lower than the 10-year high in 2014.

The fatal accident rate involving recreational aeroplanes in 2014 (38 fatal accidents per million hours flown) was significantly higher than for comparable private/business/sport (including gliding) operations (19 fatal accidents per million hours flown).

Table 24: Occurrences involving recreational aeroplane operations, 2006 to 2015[16]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	9	43	62	42	68	85	90	98	130	86
Serious incidents	4	11	16	8	17	7	35	27	39	34
Serious injury accidents	0	2	2	4	3	4	4	4	1	4
Fatal accidents	2	8	1	3	3	4	1	9	5	8
Total accidents	2	17	36	31	40	44	50	59	76	52
Number of people involved										
Serious injuries	1	3	2	4	6	5	4	5	1	4
Fatalities	2	12	2	3	4	6	2	10	7	8
Rate of aircraft involved										
Accidents per million hours	17.7	131.5	248.1	190.7	310.3	311.9	283.5	349.6	570.0	N/A
Fatal accidents per million hours	17.7	61.9	6.9	18.5	23.3	28.4	5.7	53.3	37.5	N/A

Figure 22: Accident rate for recreational aeroplane operations (per million hours flown), 2006 to 2014[16]



[16] Includes RAAus registered motorised gliders.

There were 52 recreational aircraft involved in accidents and 34 serious incidents reported to the ATSB in 2015. Seven of these accidents were fatal – one consisted of two recreational aeroplanes, and four resulted in serious injuries. The fatal accidents are described below:

- The pilot of a Howard Hughes Engineering Sp2000s was fatal injured from a collision with water off Stradbroke Island, Qld (ATSB occurrence 201501958).
- The pilot of a Jabiru J250 was fatally injured when the aircraft collided with a mountain ridge near Gympie, Qld. The ATSB provided technical assistance to RAAus during their investigation (ATSB investigation AE-2015-044).
- A Howard Hughes Engineering Light Wing GR-912 collided with terrain near Starke Field, Qld, fatally injuring the pilot (ATSB occurrence 201505527).
- An Austflight ULA Drifter A-582 and a Thruster 83 collided mid-air near Donnington Park, Qld, resulting in fatal injuries to both pilots (ATSB occurrence 201500222).
- During mustering operations at Caroonboon Station, NSW, a Moravan Incorporated, Otrokovice Savage Cub collided with terrain resulting in fatal injuries to the pilot (ATSB occurrence 201503418).
- The pilot of a Conroy Fuselage/Steve Cohen Designed Wings Pilatus was fatally injured when the aircraft collided with terrain near Wollongong aerodrome, NSW (ATSB occurrence 201500100).
- The pilot of an amateur-built Thunderbolt was fatally injured from a collision with terrain near Lovedal, NSW. The ATSB provided technical assistance to RAAus during their investigation (ATSB investigation AE-2015-044).

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

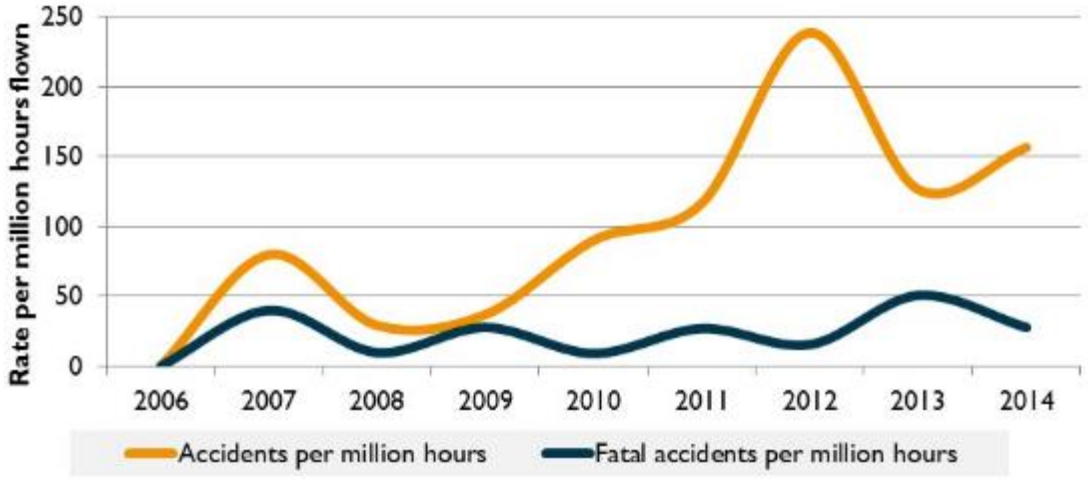
Weight shift

Weight shift aircraft refer to hang gliders, paragliders, powered parachutes, and weight-shift trikes and microlights. Over the last 10 years, 61 incidents, 19 serious incidents and 119 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 RAAus. Figure 23 shows the rate of accidents and fatal accidents involving weight shift aircraft over the 2006 to 2014 period (for which flying hours were available). Weight shift activity (as reported by the HGFA and RAAus) remained relatively constant over this period. On average, weight shift aircraft had the lowest accident rates of all types of recreational flying.

Table 25: Occurrences involving recreational weight shift operations, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	1	4	3	2	3	3	23	13	6	3
Serious incidents	1	1	1	0	0	1	7	2	3	3
Serious injury accidents	0	2	1	0	4	5	20	4	6	8
Fatal accidents	0	4	1	3	1	3	2	6	3	7
Total accidents	0	8	3	4	10	13	31	15	17	18
Number of people involved										
Serious injuries	0	2	2	0	4	7	20	4	7	8
Fatalities	0	5	1	4	1	3	3	7	3	8
Rate of aircraft involved										
Accidents per million hours	0.0	79.7	29.1	36.8	89.8	116.4	238.4	126.3	156.3	N/A
Fatal accidents per million hours	0.0	39.8	9.7	27.6	9.0	26.9	15.4	50.5	27.6	N/A

Figure 23: Accident rate for recreational weight shift operations (per million hours flown), 2006 to 2014



There were 18 accidents and three serious incidents reported in 2015 involving weight shift aircraft. Seven of these accidents resulted in fatalities, and eight resulted in a serious injury. The fatal accidents are described below:

- The pilot of a Moyes Delta Gliders LiteSpeed RX was fatally injured when the hang glider collided with terrain near Nindooinbah, Qld (ASTB occurrence 201504467).
- The pilot and a passenger were fatally injured when an AirBorne Australia Edge collided with terrain near Dundee, NSW (ATSB occurrence 201501360).
- The pilot of a Moyes Delta Gliders Litesport was fatally injured when the hang glider collided with terrain near Ben Nevis, Vic (ATSB occurrence 201500099).
- An AirBorne Australia Fun Mk 1 collided with terrain near Busselton Aerodrome, WA, fatally injuring the pilot (ATSB occurrence 201504416).
- The pilot of a Fasterway Boss Limited S2 was fatally injured when the powered parachute collided with terrain near Theodore, Qld (ATSB occurrence 201502337).
- A Gradient s.r.o. Freestyle 2 power paraglider collided with a house in Yanchep, WA resulting in fatal injuries to the pilot (ATSB occurrence 201501373).

- The pilot of an AirBorne Australia XT-912 was fatally injured when the aircraft collided with terrain near Tyagarh, NSW (ATSB occurrence 201502711).

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

Remotely Piloted Aircraft Systems

Remotely piloted aircraft systems (RPAS) refers to unmanned fixed-wing, rotary-wing, and lighter-than-air craft that are controlled by a ground-based operator (remote pilot). These aircraft may be VH- registered or not registered by CASA. RPAs are also known as unmanned aerial vehicles (UAVs) or drones. The term RPAS emphasises that there is a human 'in the loop' controlling and overseeing the aircraft. RPAS used for commercial, government or research purposes are operated under CASA's regulations in contrast to model aircraft, which are flown for sport and recreation.

In 2015 there were 22 occurrence involving the operation of RPAs (Table 26). (This does not include incidents where pilots of conventional aircraft have reported encountering an unidentified RPA/model aircraft.) This is a significant increase compared to any other year in the previous 10 years and reflects the increasing prevalence of these aircraft.

Table 26: Occurrences involving remotely piloted aircraft systems, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of aircraft involved										
Incidents	0	0	1	0	0	2	1	2	5	4
Serious incidents	0	0	0	0	0	0	1	4	1	4
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	2	3	12
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 were 12 accidents and four serious incidents reported to the ATSB involving RPAS in 2015. Most of the RPAS accidents reported to the ATSB in 2015 involved collision with terrain, often caused by mechanical/electrical failure or radio interference. Some of the notable accidents are described below:

- The ground controller lost control of DJI S1000, and the RPA subsequently collided with the water at Surfers Paradise, Qld (ATSB occurrence 201504673).
- A DJI S900 collided with the roof of a parked car in Toowoomba, Qld. Just prior to the accident, the controller heard a loud crack before the RPA descended rapidly (ATSB investigation AO-2015-112).
- During the cruise near Frazerview, Qld, an eagle struck a SenseFly eBee resulting in substantial damage (ATSB occurrence 201508025).
- An AERONAVICS SKYJIB 8 collided with terrain near Rod Laver Arena, Vic. The RPA was operating as part of the media coverage of the International Cricket Council World Cup Final, at the Melbourne Cricket Ground. Radio frequency interference was the most likely cause of the accident. The volume of radio frequency traffic at the time of the accident was probably substantial, and perhaps sufficient to override RPA control signals under the prevailing conditions (ATSB investigation AO-2015-035).

Aeronavics SkyJib 8 remotely piloted aircraft from AO-2015-035. Source: RPA operator

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 15,324 aircraft on the Australian civil aircraft (VH-) register[17], fixed-wing aircraft accounted for 83 per cent of all aircraft (11,492 powered fixed-wing aeroplanes, 273 motorised gliders and 996 unpowered gliders). Rotary-wing aircraft accounted for 14 per cent (2,164 aircraft). The remaining three per cent were balloons (399 aircraft) and one airship. At the time of writing, the number of VH-registered RPAS is not known. Australian-registered recreational aircraft are additional to these figures. There were 5,302 aircraft registered with Recreational Aviation Australia (RAAus) in late-2016 (4,364 aeroplanes and motorised gliders and 938 weight shift aircraft). Gyrocopters are registered with the Australian Sport Rotorcraft Association (ASRA) and weight-shift aircraft are registered by both the Hang Gliding Federation of Australia (HGFA) and RAAus.

In this section:

- aeroplanes refer to all manned, VH- registered powered fixed-wing aircraft, and to recreational powered aeroplanes registered by RAAus
- balloons refer to all manned, VH- registered hot air balloons and lighter-than-air craft, including dirigibles
- helicopters refer to all manned, VH- registered rotary-wing aircraft
- gliders refer to all manned, VH- registered non-powered fixed-wing aircraft, and manned, VH-registered and non-VH- registered powered gliders
- gyrocopters refer 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 RAAus 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 – around 70 per cent of all accidents (Table 27). The reporting of recreational aircraft accidents to the ATSB has improved significantly in the last 10 years. Recreational aeroplanes are involved in a similar number of the reported accidents as general aviation aeroplanes. In 2015, there was one fatal accident involving an aeroplane conducting commercial air transport operations, all other fatal accidents involved general aviation or recreational aeroplanes (Table 28).

[17] CASA registered aircraft numbers are until the end of 2015. These data were obtained from the CASA website: https://www.casa.gov.au/standard-page/data-files.

Helicopters were involved in around one-quarter of all general aviation (GA) accidents and 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 2006 and 2015, 30 per cent of all accidents and 35 per cent of all fatal accidents in Australian aviation involved recreational aircraft, even though they contributed just eight per cent of the recorded hours flown by aircraft in Australia over this period (Table 28). In the last three years of the study period, recreational aircraft were involved in around 52 per cent of all fatal accidents.

Since 2013, the number of accidents involving remotely piloted aircraft has significantly increased, from zero in 2012 to around five per cent of all accidents by 2015.

Table 27: Number of accidents involving Australian-registered aircraft, by aircraft type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Aeroplanes										
Air transport	10	16	23	11	20	16	9	9	22	6
General aviation	58	84	84	78	84	73	60	58	106	88
Recreational	2	17	36	31	40	44	50	59	76	52
Balloons										
Air transport	0	0	0	0	0	0	0	1	1	0
General aviation	1	2	3	3	2	3	1	0	2	0
Helicopters										
Air transport	1	5	5	2	3	5	4	5	3	1
General aviation	25	25	35	33	36	25	27	24	28	35
Gliders										
General aviation	6	5	4	3	3	12	12	8	10	6
Recreational	0	0	0	0	0	0	0	0	0	0
Gyrocopters										
Recreational	2	4	2	4	6	4	6	7	5	4
Remotely Piloted Aircraft										
General aviation[18]	0	0	0	0	0	0	0	2	3	12
Weight Shift										
Recreational aircraft	0	8	3	4	10	13	31	15	17	18

[18] Between 2006 and 2015, most RPAs were not required to be registered in Australia. As with the other aircraft types in the table, the number of RPA accidents refers to all those reported to the ATSB, not just Australian registered aircraft.

Table 28: Number of fatal accidents involving Australian-registered aircraft, by aircraft type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Aeroplanes										
Air transport	1	1	2	0	1	2	1	1	0	1
General aviation	12	9	18	7	8	6	14	12	9	5
Recreational	2	8	1	3	3	4	1	9	5	8
Balloons										
Air transport	0	0	0	0	0	0	0	1	0	0
General aviation	0	0	0	0	0	0	0	0	0	0
Helicopters										
Air transport	0	1	1	0	0	0	0	0	0	0
General aviation	4	2	2	8	4	9	4	2	2	4
Gliders										
General aviation	3	1	2	1	0	1	2	1	0	1
Recreational	0	0	0	0	0	0	0	0	0	0
Gyrocopters										
Recreational	2	4	0	2	2	0	3	1	1	2
Remotely Piloted Aircraft										
General aviation[19]	0	0	0	0	0	0	0	0	0	0
Weight Shift										
Recreational aircraft	0	4	1	3	1	3	2	6	3	7

Differences in accidents between specific operation types and aircraft types

Considering flying activity, private ballooning had by far the highest accident rate. The accident rate involving helicopters in almost all types of operations is higher than for aeroplanes conducting the same type of operation (Table 29). 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 2006 to 2014 period was highest for gyrocopters, followed by aeroplanes used for recreational 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 29 and Figure 24). These differences are discussed below.

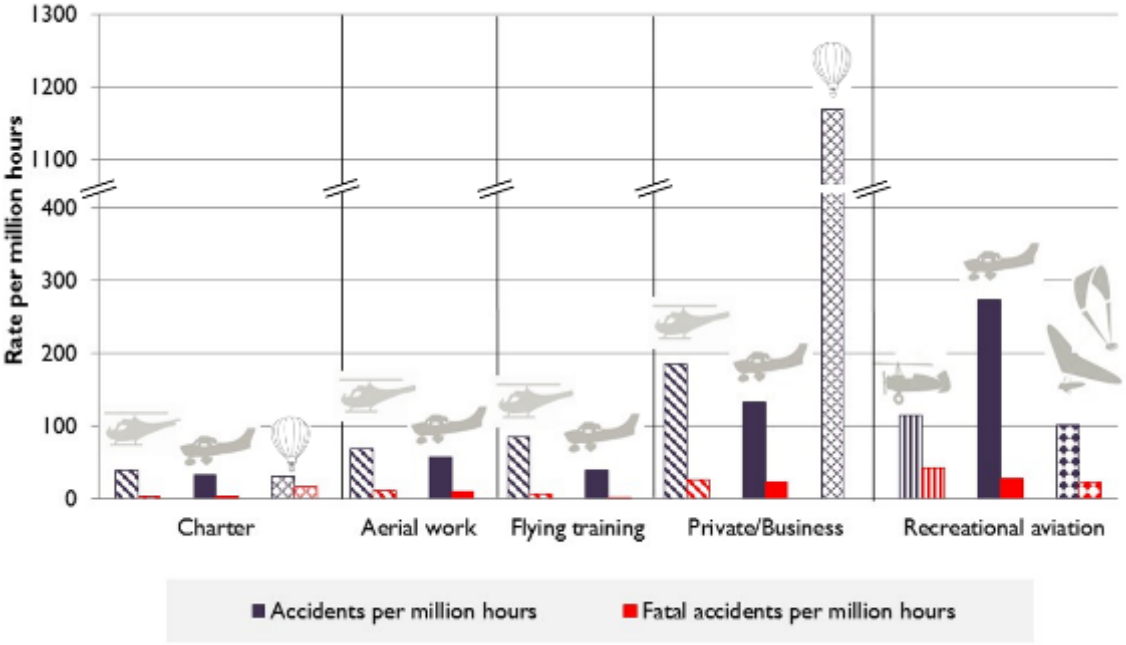
[19] Between 2006 and 2015 most RPAs were not required to be registered in Australia. The number of RPA fatal accidents refers to all those reported to the ATSB, not just Australian registered as with the other aircraft types in the table.

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

Table 29: Rate of accidents and fatal accidents by operation and aircraft type, 2006-2014

Operation	Aircraft type	Accidents per million hours	Fatal accidents per million hours
Charter	Helicopters	38.4	2.5
	Aeroplanes	31.6	2.3
	Balloons	30.1	15.0
Aerial work	Helicopters	68.4	11.4
	Aeroplanes	57.3	9.4
Flying training	Helicopters	84.4	5.6
	Aeroplanes	39.3	1.5
Private/business	Helicopters	184.4	25.4
	Aeroplanes	132.3	21.7
	Balloons	1169.6	0.0
Recreational aviation	Gyrocopters	113.7	42.6
	Aeroplanes	273.5	27.7
	Weight Shift	101.1	23.0

Figure 24: Rate of accidents and fatal accidents by operation and aircraft type



Over the 2006 to 2014 period, all air transport using helicopters were charter operations, so the only air transport comparison for aircraft types provided here is for charter.

Charter

Helicopters involved in charter air transport operations had slightly higher accident rates (about 38 versus 32 accidents per million hours flown over the 2006 to 2014 period) than charter aeroplanes.

The rate of fatal accidents over this period involving helicopters was the same for aeroplanes (2.5 per million hours flown).There were fewer fatalities in charter helicopter accidents (five) than in charter aeroplane accidents (11). There were two charter balloon accidents over this period, including one fatal accident in 2013.

In 2014, charter hours flown by aeroplanes (about 288,000) were more than three times higher than helicopter charter hours (about 82,900). There were about 8,700 charter hours flown by balloons.

Aerial work

Aeroplanes involved in all types of aerial work had a lower accident rate than for helicopters conducting aerial work (about 57 versus 68 per million hours flown over the 2006 to 2014 period). There are, however, significant differences in the types of aerial work that are performed by aeroplanes as opposed to helicopters.

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 nine per million hours flown). The number of fatalities involving helicopters and aeroplanes were similar (33 versus 27).

The amount of aerial work conducted by helicopters and aeroplanes was about equal. In 2014, about 282,100 hours were flown by helicopters conducting aerial work, compared to 214,400 for aeroplanes. In aerial agriculture, about twice as many hours were flown by aeroplanes in 2014 (52,500) than by helicopters (23,700).

Flying training

The helicopter accident rate from 2006 to 2014 was about 84 per million hours flown, which was more than double that for aeroplanes conducting flying training (about 39 accidents per million hours flown). Most flying training was done in aeroplanes. In 2014, about 299,000 hours of aeroplane flying training were recorded by the BITRE (compared to about 26,700 for helicopters). A large fall in aeroplane flying training in Australia has occurred in recent years, with 34 per cent fewer hours flown in 2014 compared to a peak of 454,000 hours flown in 2009 (the highest of any year since 1990).

The fatal accident rate over the 2006 to 2014 period for helicopter flying training (about 5.6 per million hours flown) was notably higher than that for aeroplanes (about 1.5 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 2006 to 2014 period that was about 40 per cent higher than that for aeroplanes (about 184 accidents per million hours for helicopters, compared to 132 per million hours flown for aeroplanes). Balloons being used for private flying had the highest accident rate over this period (1,170 per million hours flown), due to 17 accidents and a relatively small amount of flying activity. There were 1,332 hours flown in balloons used for other than charter in 2014, compared to 33,000 for helicopters and 326,000 for aeroplanes.

Helicopters also had a higher fatal accident rate (25 versus 22 fatal accidents per million hours flown). Due to the higher use of aeroplanes for private/business flying over this period compared to helicopters, there were significantly more fatalities in those fatal accidents involving aeroplanes than in helicopter accidents. There were no private fatal balloon accidents over this period.

Recreational aviation

The fatal accident rate for gyrocopters over this period (43 per million hours flown) was significantly higher than that of other recreational aircraft (28 per million hours flown for recreational aeroplanes, and 23 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 higher than for private/business aeroplanes (28 versus 22 fatal accidents per million hours flown), as was the overall accident rate (about 274 versus 132 accidents per million hours flown).

Weight shift aircraft had a low accident rate compared to most other recreational aircraft/operation types (101 per million hours flown). The weight shift fatal accident rate (23 per million hours flown) was higher than average when compared to all other aircraft/operation types excluding private/business helicopters.

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 are:

- 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 once, 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 2015, the most common accidents and serious incidents in air transport operations (Table 30) were related to:

- aircraft control
- aircraft separation
- aircraft system issues
- terrain collisions

- powerplant and propulsion
- weather
- crew and cabin safety.

Table 30: Accidents and serious incidents in air transport operations, by occurrence type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	4	17	10	7	14	7	18	16	7	9	109
Operational Non-compliance	0	5	6	3	2	2	1	3	0	2	24
ANSP Operational error	1	2	1	0	0	2	1	2	1	0	10
Airspace infringement	0	1	1	1	0	0	0	0	0	0	3
Breakdown of co-ordination	0	0	0	0	1	0	0	0	0	0	1
Other	0	1	0	0	0	0	0	0	0	0	1
Environment											
Weather	0	4	5	4	6	0	6	6	5	3	39
Wildlife	0	2	0	0	1	0	1	1	0	2	7
Interference with aircraft from ground	0	0	1	0	0	0	0	1	1	0	3
Infrastructure											
Other	0	0	0	0	0	0	0	0	0	0	0
Operational											
Aircraft control	6	15	20	11	14	6	13	11	18	9	123
Terrain Collisions	5	8	13	6	8	11	7	6	9	4	77
Crew and cabin safety	4	11	18	9	5	6	6	4	10	3	76
Runway events	5	8	8	1	5	7	6	10	12	2	64
Communications	2	2	4	2	3	3	5	2	5	2	30
Fuel related	0	4	6	3	1	2	2	7	2	1	28
Ground operations	1	1	1	1	1	4	3	4	6	2	24
Fumes, Smoke, Fire	1	1	7	3	2	1	1	2	3	2	23
Flight preparation / Navigation	0	4	0	2	4	0	2	4	1	2	19
Miscellaneous	2	0	6	3	5	0	1	1	1	0	19
Ground proximity alerts / warnings	0	2	0	1	0	0	2	1	1	1	8
Aircraft loading	0	0	0	0	1	0	0	0	1	1	3
Technical											
Powerplant / propulsion	5	9	18	6	11	12	8	10	8	4	91
Systems	2	6	10	6	3	4	2	3	5	6	47
Airframe	1	4	2	4	5	5	5	4	10	2	42
Consequential events	**12**	**18**	**30**	**18**	**24**	**16**	**12**	**22**	**15**	**15**	**182**

Aircraft control

There were two accidents (including one fatal) and seven serious incidents relating to aircraft control issues in air transport aircraft reported to the ATSB in 2015. The majority of the aircraft control accidents and serious incidents occurred during the approach or landing phase of flight. The fatal accident and three of the serious incidents involved an aircraft conducting charter operations.

Aircraft separation

There were nine serious incidents in 2015 involving air transport aircraft with separation or aircraft proximity issues. 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.

Aircraft systems issues

In 2015, there were six aircraft systems serious incidents involving aircraft from medical transport (1), charter (2), low capacity (2) and high capacity (1) operation types within air transport.

Terrain collisions

There were two accidents and two serious incident terrain collisions involving air transport aircraft – all charter – reported to the ATSB in 2015, one resulted in fatal injuries. This number of terrain collision accidents in 2015 was the lowest reported in the study period for air transport.

Powerplant / propulsion

One accident and three serious incidents relating to engine malfunctions on air transport aircraft were reported to the ATSB in 2015. In most cases, a power loss occurred during take-off / initial climb, and the pilot had time to make a diversion or a successful forced landing.

Weather

There were two accidents and one serious incident reported to the ATSB in 2015 involving weather – including one serious injury incident. This was consistent with the 10-year average of around four per year.

Crew and cabin safety

There were three accidents relating to cabin and crew safety, reported in 2015, involving an air transport aircraft. All of these events resulted in serious injuries.

Incidents

The most common incident types in 2015 involving air transport operations (Table 31) were:

- wildlife strikes
- aircraft system issues
- weather-related issues

Table 31: Incidents in air transport operations, by occurrence type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	149	127	187	164	161	191	222	245	263	193	1,902
ANSP Operational error	253	190	173	129	75	50	59	99	119	24	1,171
Operational Non-compliance	62	104	115	78	100	95	114	119	126	74	987
Airspace infringement	16	26	25	16	10	13	20	16	18	7	167
Breakdown of co-ordination	10	26	26	20	16	4	13	16	20	6	157
Other	16	3	6	4	1	1	5	7	2	5	50
Environment											
Wildlife	952	986	1,093	1,207	1,372	1,453	1,370	1,439	1,425	1,404	12,701
Weather	126	147	177	141	209	254	302	464	550	438	2,808
Interference with aircraft from ground	4	6	1	3	5	6	8	9	8	16	66
Infrastructure											
Runway lighting	19	16	18	26	22	13	22	14	15	11	176
Other	15	17	11	8	6	4	7	11	5	5	89
Navaids	8	2	3	4	7	5	2	2	8	19	60
ATM	7	4	5	1	5	0	1	1	4	3	31
Radar / Surveillance	0	0	2	2	6	3	8	2	0	1	24
Operational											
Miscellaneous	223	242	330	302	273	282	395	273	277	203	2,800
Fumes, Smoke, Fire	102	125	146	139	266	292	305	289	294	252	2,210
Aircraft control	92	82	98	83	96	136	211	220	221	181	1,420
Aircraft loading	78	115	91	65	124	221	222	202	191	83	1,392
Ground proximity alerts / warnings	149	83	37	22	20	38	69	172	220	232	1,042
Crew and cabin safety	52	96	73	69	86	121	92	151	140	90	970
Communications	116	91	141	97	72	75	86	97	91	70	936
Ground operations	58	67	68	50	49	78	72	59	58	39	598
Runway events	43	41	56	47	52	66	69	63	68	57	562
Flight preparation / Navigation	70	84	59	31	41	54	54	50	42	41	526
Fuel related	33	55	52	35	30	36	32	35	30	34	372
Terrain Collisions	13	14	15	10	9	8	5	13	5	5	97
Technical											
Systems	287	328	369	311	430	487	515	494	500	499	4,220
Airframe	161	188	246	219	251	309	271	268	229	210	2,352
Powerplant / propulsion	170	209	215	212	176	218	244	199	180	155	1,978
Consequential events	**622**	**620**	**715**	**701**	**652**	**744**	**865**	**827**	**812**	**759**	**7,317**

Wildlife strikes

The majority of wildlife strikes involving air transport aircraft were birdstrikes, with a small number of animal strikes reported. The number of birdstrikes has increased by around 47 per cent over the last decade, driven by the large increase in aircraft movements (departures and landings) in high capacity RPT operations over the same period.

The ATSB biennially publishes a report detailing wildlife strike statistics, the most recent report *Australian aviation wildlife strike statistics* is scheduled to be published early 2017 (ATSB report AR-2016-063).

Aircraft system problems

Around 46 per cent 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.

Approximately 16 per cent of all aircraft system issues involved issues with flight controls, 14 per cent were air and pressurisation system issues. Similar proportions were electrical issues – particularly generator failures, flight control problems, or hydraulic issues.

Very few incidents (around two per cent of all systems issues) related to anti-ice protection or fuel system problems.

Weather

The ATSB received 438 reports of weather-related incidents that affected safe air transport operations in 2015. Around 85 per cent of all weather-related incidents reported to the ATSB in 2015 involved windshear or turbulence. This figure has increased almost five-fold since 2009 from around 81 reported events per year to 374 in 2015. The increase in windshear or turbulence events has significantly outpaced the increase in air transport activity over the decade. An increase of this magnitude has not been observed in other aviation operation types.

General aviation

Accidents and serious incidents

In 2015, the most common accidents and serious incidents involving GA aircraft (Table 32) were:

- terrain collisions
- aircraft control
- aircraft separation
- powerplant / propulsion issues.

Table 32: Accidents and serious incidents in GA operations, by occurrence type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	21	22	36	28	34	42	58	66	43	44	394
Operational Non-compliance	6	5	12	8	3	7	10	7	5	5	68
ANSP Operational error	2	0	4	3	1	2	1	1	0	0	14
Airspace infringement	1	1	2	3	1	1	0	2	1	0	12
Other	0	0	0	0	0	0	0	1	0	0	1
Environment											
Weather	4	13	2	10	8	3	7	5	9	9	70
Wildlife	0	2	2	3	3	5	1	3	3	4	26
Infrastructure											
Other	1	0	0	1	0	0	0	0	1	0	3
Runway lighting	0	0	0	0	0	0	1	0	0	0	1
Operational											
Terrain Collisions	75	99	116	82	138	104	96	89	100	95	994
Aircraft control	35	44	50	44	38	48	44	58	65	52	478
Runway events	10	22	20	22	21	18	19	21	26	21	200
Fuel related	4	6	9	8	14	16	16	7	9	20	109
Communications	2	1	10	4	6	11	14	17	12	8	85
Ground operations	0	5	1	5	2	4	3	3	12	11	46
Flight preparation / Navigation	2	4	4	5	0	4	6	5	4	7	41
Fumes, Smoke, Fire	4	4	5	6	4	2	3	2	3	4	37
Crew and cabin safety	3	3	4	3	2	5	1	2	4	3	30
Miscellaneous	1	0	2	1	4	2	3	4	3	6	26
Aircraft loading	0	1	1	1	0	0	0	0	1	0	4
Technical											
Powerplant / propulsion	37	64	39	50	41	36	40	32	32	33	404
Airframe	4	3	5	8	10	7	6	16	15	10	84
Systems	2	3	4	5	9	9	2	3	6	8	51
Consequential events	42	62	49	59	68	55	66	57	60	65	583

Terrain collisions

About two-thirds of the terrain collisions in 2015 that involved a GA aircraft were collisions with terrain (62 accidents). Most other terrain collisions reported to the ATSB were ground strikes during take-off or landing or wirestrikes. There were 16 accidents and three serious incident ground strikes in 2015. The number of wirestrikes in 2015, five accidents and seven serious incidents – including no fatal accidents, was the lowest over the decade.

Aircraft separation

In 2015, 69 GA aircraft were involved in 44 aircraft separation serious incidents. One of these occurrences resulted in minor injury. Two were collisions – both investigated by the ATSB – and 39 were near collisions with 12 investigated by the ATSB in 2015.

Aircraft control

There were 52 aircraft control accidents or serious incidents reported to the ATSB involving GA aircraft in 2015. This was slightly greater than the 10-year average of 48 per year.

There were 46 accidents – two fatal and two serious injury accidents – and six serious incidents. Of these occurrences, 18 were investigated by the ATSB. The most common control issues were loss of control and hard landings.

Powerplant and propulsion

In 2015, there were 16 accidents – one resulting in serious injury – and 17 serious incidents relating to engine-related issues reported to the ATSB involving GA aircraft. This was consistent with the 10-year average this report covers and made up around eight per cent of all GA accidents or serious incidents.

The majority of these engine-related accidents and serious incidents were due to an engine failure or malfunction. Around 40 per cent 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.

Incidents

The most common types of incidents involving GA aircraft in 2015 (Table 33) were:

- wildlife strikes
- aircraft separation
- runway events
- aircraft system problems.

Table 33: Incidents in GA operations, by occurrence type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	128	133	177	178	146	192	177	186	174	179	1,670
Operational Non-compliance	95	123	263	213	193	183	161	125	91	81	1,528
Airspace infringement	71	69	58	49	39	40	41	37	24	16	444
ANSP Operational error	66	58	59	44	27	19	30	52	37	17	409
Breakdown of co-ordination	2	9	7	4	7	2	11	14	6	2	64
Other	0	1	1	1	1	1	2	5	1	2	15
Environment											
Wildlife	359	353	323	361	376	322	286	287	269	286	3,222
Weather	11	26	15	8	18	17	17	15	15	10	152
Interference with aircraft from ground	3	1	3	0	2	1	5	2	2	9	28
Infrastructure											
Other	2	3	2	2	2	4	5	2	1	1	24
ATM	7	0	2	1	0	0	0	2	0	1	13
Runway lighting	2	0	2	0	2	0	2	2	1	1	12
Radar / Surveillance	0	0	1	0	2	1	0	0	1	0	5
Navaids	0	0	0	1	0	1	0	0	0	1	3
Operational											
Runway events	260	229	295	450	300	260	239	243	142	169	2,587
Communications	174	122	199	147	135	119	119	127	112	92	1,346
Flight preparation / Navigation	118	118	73	74	65	51	46	61	40	35	681
Aircraft control	50	67	52	54	40	51	57	52	41	47	511
Terrain Collisions	28	43	43	51	31	34	35	41	11	16	333
Fumes, Smoke, Fire	37	38	33	28	36	35	31	29	30	17	314
Miscellaneous	19	18	31	27	32	37	31	26	33	15	269
Ground operations	26	28	24	30	32	20	26	27	35	20	268
Fuel related	13	17	19	13	21	19	14	12	25	20	173
Crew and cabin safety	7	8	2	4	5	5	3	4	4	2	44
Aircraft loading	1	4	4	1	3	1	2	1	2	1	20
Ground proximity alerts / warnings	0	0	0	1	0	1	0	0	0	2	4
Technical											
Systems	141	127	111	122	158	155	148	126	162	157	1,407
Powerplant / propulsion	121	159	148	136	111	133	142	114	121	129	1,314
Airframe	127	113	115	130	124	141	139	121	127	131	1,268
Consequential events	**317**	**279**	**294**	**311**	**276**	**293**	**310**	**275**	**277**	**305**	**2,937**

Wildlife

Reporting of wildlife strikes involving GA aircraft has reduced by around 30 per cent since its peak in 2010. However, wildlife strikes were still the most commonly reported GA safety incident – making up around 15 per cent.

Runway events

The number of runway events reported to the ATSB in 2015 involving GA aircraft was the second lowest over the 10-year period and was significantly below the 10-year average. Runway incursion

was the most commonly reported incident, almost all involving an incursion by an aircraft due to the pilot's actions.

Runway excursions accounted for the second largest share of runway events reported to the ATSB in 2015.

Aircraft separation

Aircraft separation incident made up around 14 per cent of all GA incidents reported to the ATSB in 2015. More than 20 per cent of these occurrences involved one aircraft where the operation type was unknown.

Separation issue was the most commonly reported aircraft separation incident. Loss of separation or loss of separation assurance were the second most commonly reported incidents.

Recreational aviation

Accidents and serious incidents

Accident and serious incident reporting in the recreational aviation community has increased in recent years, as shown by the difference in the number of occurrences reported to the ATSB in 2006 compared to 2015 (Table 34). 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 2015 were:

- terrain collisions
- powerplant / propulsion
- aircraft control
- runway events.

Table 34: Accidents and serious incidents in recreational aviation, by occurrence type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	2	3	6	2	3	1	5	4	9	7	42
Airspace infringement	1	0	0	0	0	0	0	0	1	1	3
Operational Non-compliance	0	0	0	1	0	0	1	0	0	0	2
Other	0	0	0	0	0	0	0	1	0	0	1
Environment											
Weather	0	0	1	1	3	0	6	5	4	7	27
Wildlife	0	0	1	0	1	0	0	3	1	0	6
Infrastructure	0	0	0	0	0	0	0	0	1	0	1
Operational											
Terrain Collisions	7	25	28	33	34	48	60	64	65	61	425
Aircraft control	0	10	12	8	20	17	44	38	49	24	222
Runway events	0	2	6	6	4	10	11	15	15	17	86
Fuel related	0	1	4	1	0	3	6	8	13	9	45
Ground operations	0	2	0	1	1	0	2	0	7	4	17
Communications	0	1	3	2	0	1	1	1	1	2	12
Flight preparation / Navigation	0	0	0	1	0	0	1	1	2	4	9
Fumes, Smoke, Fire	0	1	1	1	3	0	0	1	1	0	8
Aircraft loading	0	0	0	0	0	1	0	0	1	0	2
Crew and cabin safety	0	0	0	0	0	0	1	0	1	0	2
Miscellaneous	0	0	1	0	0	0	0	0	0	0	1
Technical											
Powerplant / propulsion	0	14	17	10	22	17	40	35	32	35	222
Airframe	0	0	3	2	3	1	10	4	7	6	36
Systems	0	0	2	2	0	0	4	4	3	3	18
Consequential events	**0**	**11**	**24**	**9**	**25**	**18**	**38**	**35**	**54**	**33**	**247**

Terrain collisions

There were 61 terrain collisions involving recreational aircraft that were reported to the ATSB in 2015 that were classified as an accident or serious incident. Sixteen involved fatal injuries (26 per cent) and 14 involved serious injuries to the aircraft occupants.

Most (46) terrain collision accidents were collisions with terrain, with 19 ground strikes and two wirestrike also reported.

Powerplant / propulsion

There were 15 powerplant-related accidents and 20 serious incidents involving recreational aircraft reported to the ATSB in 2015. There were no fatal and three serious injury accidents.

All except two of the reported accidents and serious incidents involved engine failure or malfunctions, most requiring a forced landing. As almost all powered recreational aircraft are single-engine, a forced landing is generally the only remaining option for the pilot.

Aircraft control

There were 24 aircraft control issues reported in recreational aviation in 2015 – around 11 per cent of all recreational reported accidents/serious incidents. This was the lowest number of reported occurrences of this type since 2011. Most involved aeroplanes.

The 24 occurrence, including 18 accidents, were mostly hard landings or losses of control. Of these, there were no fatal and two serious injury accidents.

Runway events

There were 11 accidents and six serious incident runway events reported to the ATSB in 2015 involving recreational aircraft. There were no fatal but one serious injury accidents. One of these involved a weight shift aircraft. The most common runway event reported was runway excursion.

Incidents

The most commonly reported types of incidents to the ATSB in 2015 (Table 35) that involved recreational aviation operations were:

- powerplant / propulsion
- runway events
- aircraft separation.

Table 35: Incidents in recreational aviation, by occurrence type, 2006 to 2015

	2006	2007	2008	200+	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	3	3	3	9	4	5	6	5	18	12	68
Operational Non-compliance	2	2	1	2	2	4	3	4	3	4	27
Airspace infringement	0	2	1	4	2	1	1	2	5	0	18
ANSP Operational error	2	0	0	0	0	0	0	0	1	1	4
Environment											
Wildlife	0	2	2	2	3	5	0	4	3	6	27
Weather	0	0	2	0	2	4	4	2	2	3	19
Interference with aircraft from ground	0	0	0	0	0	0	0	0	0	1	1
Infrastructure											
Other	0	1	2	0	0	0	0	0	0	0	3
Operational											
Aircraft control	0	11	12	9	10	19	31	30	9	7	138
Runway events	2	7	10	8	11	12	20	23	21	17	131
Terrain Collisions	0	14	16	6	15	18	19	25	5	8	126
Communications	6	0	6	5	5	4	3	8	10	10	57
Flight preparation / Navigation	1	1	2	1	1	3	4	3	4	4	24
Ground operations	0	3	3	1	0	2	5	2	5	3	24
Fuel related	0	2	3	0	1	2	4	2	5	4	23
Fumes, Smoke, Fire	0	1	3	1	2	2	3	4	4	2	22
Miscellaneous	0	1	2	0	0	0	1	0	1	1	6
Crew and cabin safety	0	0	1	0	0	0	1	0	0	0	2
Aircraft loading	0	0	0	0	0	0	1	0	0	0	1
Technical											
Powerplant / propulsion	0	11	14	4	24	18	18	24	50	18	181
Airframe	0	6	10	8	12	18	16	19	20	11	120
Systems	0	2	1	1	4	5	9	5	13	8	48
Consequential events	**1**	**8**	**16**	**8**	**29**	**20**	**28**	**19**	**43**	**26**	**198**

Powerplant / propulsion

There were 18 powerplant-related incidents reported to the ATSB in 2015 involving recreational aircraft. Around two-thirds of these incidents involved engine failure or malfunction.

Runway events

There were 17 runway events involving a recreational aircraft reported to the ATSB in 2015, making up around 11 per cent of all recreational reported incidents. The number of events is consistent with the 10-year average. Half of the runway incidents were runway incursions (9) and around one-quarter were runway excursions.

Aircraft separation

Aircraft separation incidents made up around eight per cent of all recreational incidents reported to the ATSB in 2015. Separation issue was the most commonly reported aircraft separation incident.

Remotely Piloted Aircraft Systems

Accidents and serious incidents

The number of accidents and serious incidents involving an RPAS increased significantly in 2015, as shown by the difference in the number of occurrences reported to the ATSB over the 10-year period (Table 36). This is a reflection of how common this type of aircraft is becoming in Australia.

The most common types of accidents and serious incidents involving an RPAS in 2015 were:

- terrain collisions
- aircraft control
- powerplant / propulsion
- aircraft systems.

Table 36: Accidents and serious incidents involving an RPAS, by occurrence type, 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	0	0	0	0	0	0	0	1	0	0	1
Environment											
Wildlife	0	0	0	0	0	0	0	1	0	1	2
Interference with aircraft from ground	0	0	0	0	0	0	0	0	1	0	1
Operational											
Terrain Collisions	0	0	0	0	0	0	0	3	3	11	17
Aircraft control	0	0	0	0	0	0	0	1	1	8	10
Miscellaneous	0	0	0	0	0	0	0	0	0	1	1
Technical											
Powerplant / propulsion	0	0	0	0	0	0	1	3	0	2	6
Systems	0	0	0	0	0	0	0	1	1	3	5
Consequential events	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**1**	**4**

Terrain collisions

In 2015, most (10) of the terrain collision accidents involving an RPAS were collisions with terrain, the other was a controlled flight into terrain.

Powerplant / propulsion

There was one RPAS powerplant-related accident and one serious incident, reported to the ATSB 2015, both involved engine failure.

Aircraft control

There was one in-flight break-up involving an RPAS reported to the ATSB in 2015. All of the other aircraft control accidents or serious incidents were loss of control.

Aircraft systems

Two of the three RPAS aircraft system accidents or serious incidents involved electrical issues with the aircraft.

Incidents

There were seven incidents involving an RPAS reported to the ATSB in 2015 (Table 37), each involving just one occurrence. Airspace-related occurrences accounted for four of the seven incidents.

Table 37: Incidents involving an RPAS, by occurrence type, 2006 to 2015[21]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Airspace											
Aircraft separation	0	0	0	0	0	0	0	0	3	1	4
Airspace infringement	0	0	0	0	0	0	1	0	0	1	2
Operational Non-compliance	0	0	1	0	0	0	0	0	0	1	2
Other	0	0	0	0	0	0	0	0	0	1	1
Operational											
Aircraft control	0	0	0	0	0	1	1	1	1	0	4
Communications	0	0	1	0	0	0	0	0	0	1	2
Technical											
Systems	0	0	0	0	0	2	1	1	1	0	5
Powerplant / propulsion	0	0	0	0	0	1	0	1	0	1	3
Consequential events	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**2**

[21] Does not include 41 incidents involving near encounters with manned aircraft with unidentified RPAS/model aircraft (20 of which were from 2015).

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.

Analysis methodology

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 by aircraft type*
- *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 expect where the aircraft are of the same operation type where they are recorded once.
- Aircraft involved in fatal accidents are counted based on what happens to the aircraft occupants. This means that each aircraft with an on-board 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 on-board 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]
- *Medical transport* - operations involving flights facilitating emergency medical assistance in and/or transport by carrying ill or injured persons as medical passengers, other persons directly involved with the medical passenger, and/or medical personnel.

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 flying for the purposes of agriculture (spraying and spreading), 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.

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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'.

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 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 (RAAus) (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.

Remotely piloted aircraft (RPAs) refer to occurrences involving unmanned fixed-wing, rotary-wing or lighter-than-air craft that are controlled by a ground-based operator conducting commercial, government or research activities and not flown for sport or recreation.

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 (pre-2014) 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
		Loss of control

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		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
		Runway excursion

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		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 operations involving the travelling public.

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.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

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 2006 to 2015
AR-2016-122
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