



CAD/PAD

Mishap Investigation

Support Team

2016

Jacob J. Parkin
AFLCMC/EBHJ E23
Hill AFB, UT
Jacob.Parkin@us.af.mil

CAD/PAD Technical Exchange Workshop
May 2016



CAD/PAD Mishap Investigation Support Team

- **Mishap Investigation Objectives**
- **Mishap Investigation Support Cost**
- **USAF Ejections Statistics**
- **Ejections of Interest**



Mishap Investigation Objectives

- **AFI 91-204/AFMAN 91-223 provides for technical guidance for Safety Investigation Boards (SIB)**
 - **Agreement between AFLCMC/EBHJ and USAF Safety Center (AFSEC) provides for investigation of all USAF mishaps where egress systems, CAD/PAD are involved**
- **The SIB president must request support from the CAD/PAD Mishap Investigation Support Team (MIST) through the AFSEC**
 - **FMS can request MIST support but will need to provide the funding**
- **Purpose:**
 - **Determine if there was an ejection attempt**
 - **Identify and correct CAD/PAD and other egress system deficiencies**
 - **A successful ejection can still have a component failure**
 - **Extension of CAD/PAD surveillance program**
 - **Modern ejection systems are built with redundancies**



Mishap Investigation Support Costs

CY	# Supported	Days	TDY Cost
2006	7	52	\$14,628.27
2007	11	84	\$25,492.12
2008	4	53	\$15,918.61
2009	3	30	\$5,099.62
2010	5	45	\$13,998.81
2011	7	69	\$21,568.56
2012	6	48	\$21,275.65
2013	4	80	\$19,231.23
2014	4	84	\$28,439.62
2015	5	80	\$20,637.04
10 Year Total		625	\$186,289.53
10 Year Average		63	\$18,628.95



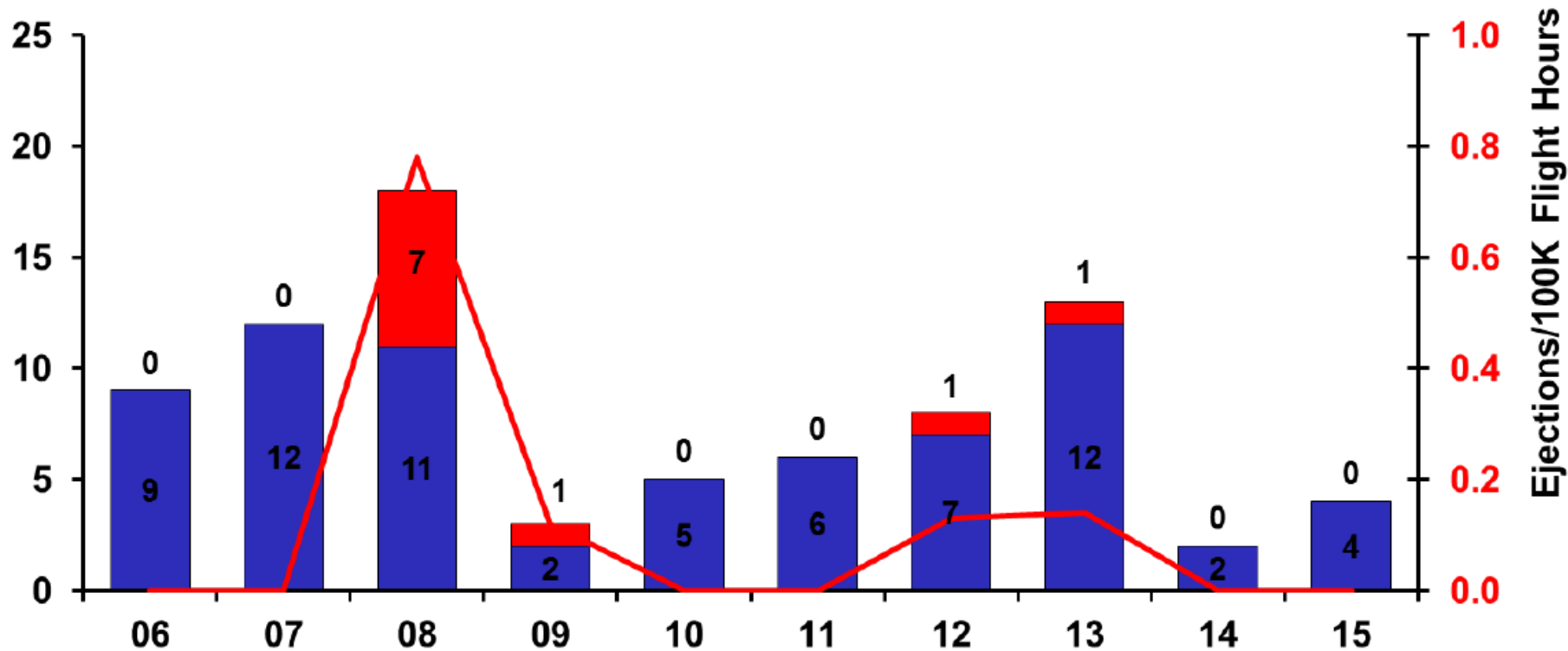
All USAF Ejections FY 06 – FY 15

	Total	Survived	Rate	Fatal	Rate
F-35	0	0	N/A	0	N/A
F-16	26	25	96%	1	4%
F-15	17	15	88%	2	12%
F-22	2	1	50%	1	50%
A-10	3	3	100%	0	0%
B-1	4	4	100%	0	0%
B-2	2	2	100%	0	0%
B-52	2	0	0%	2	100%
T-38	12	8	67%	4	33%
T-6	9	9	100%	0	0%
U-2	0	0	N/A	0	N/A
F-4	3	3	100%	0	0%
	80	70	88%	10	12%



All USAF Ejections FY 06 – FY 15

■ Successful
 ■ Fatal
 — Fatal/100K Flt-hr



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
10-Year (FY 06-15):	80 / 0.96	10 / 0.12



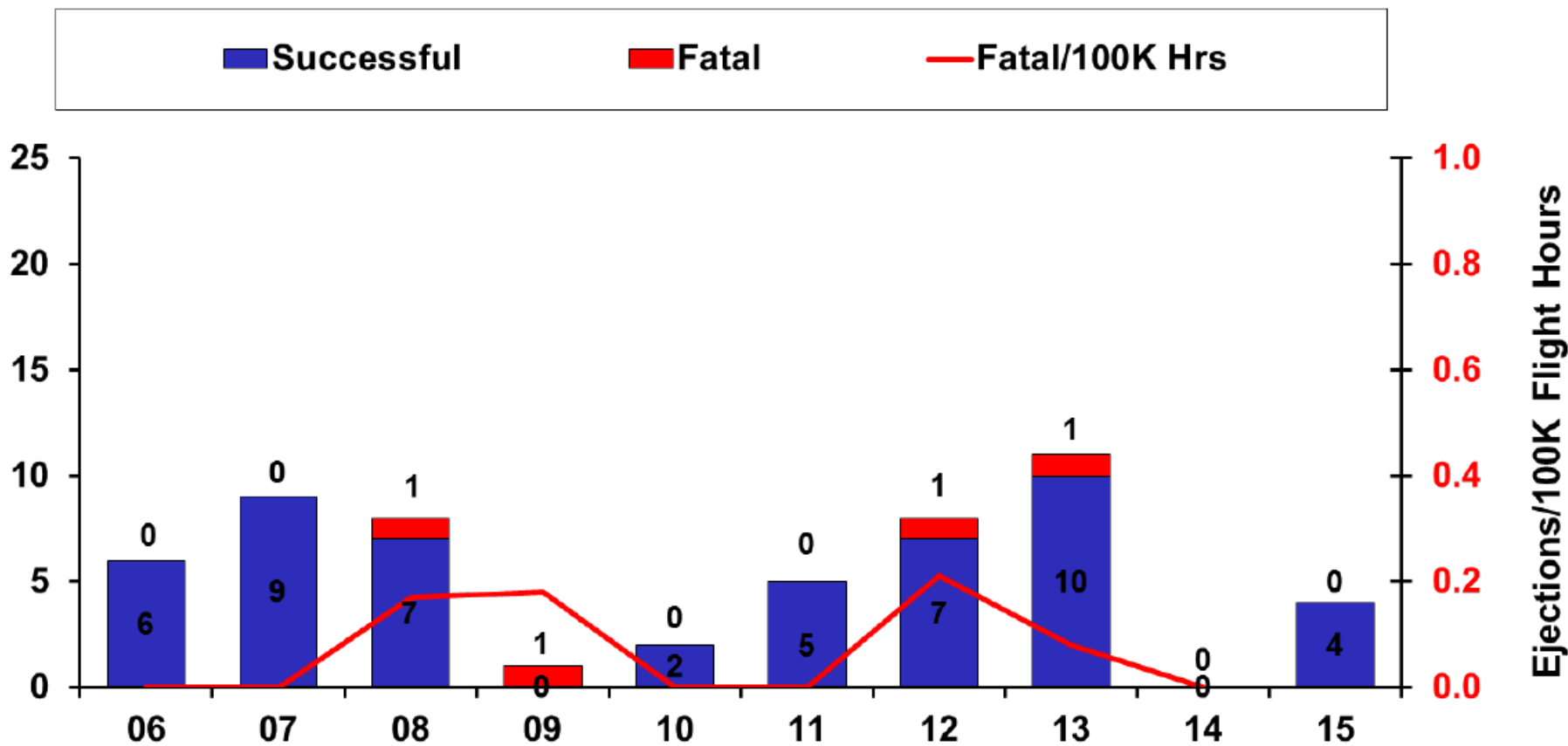
USAF ACES II Ejections

8 Aug 78 to present

	Total	Survived	Rate	Fatal	Rate
F-16	299	278	93%	21	7%
F-15	89	81	91%	8	9%
A-10	55	45	82%	10	18%
B-1B	24	23	96%	1	4%
F-117	2	2	100%	0	0%
F-22	3	2	67%	1	33%
B-2	2	2	100%	0	0%
	473	432	91%	41	9%



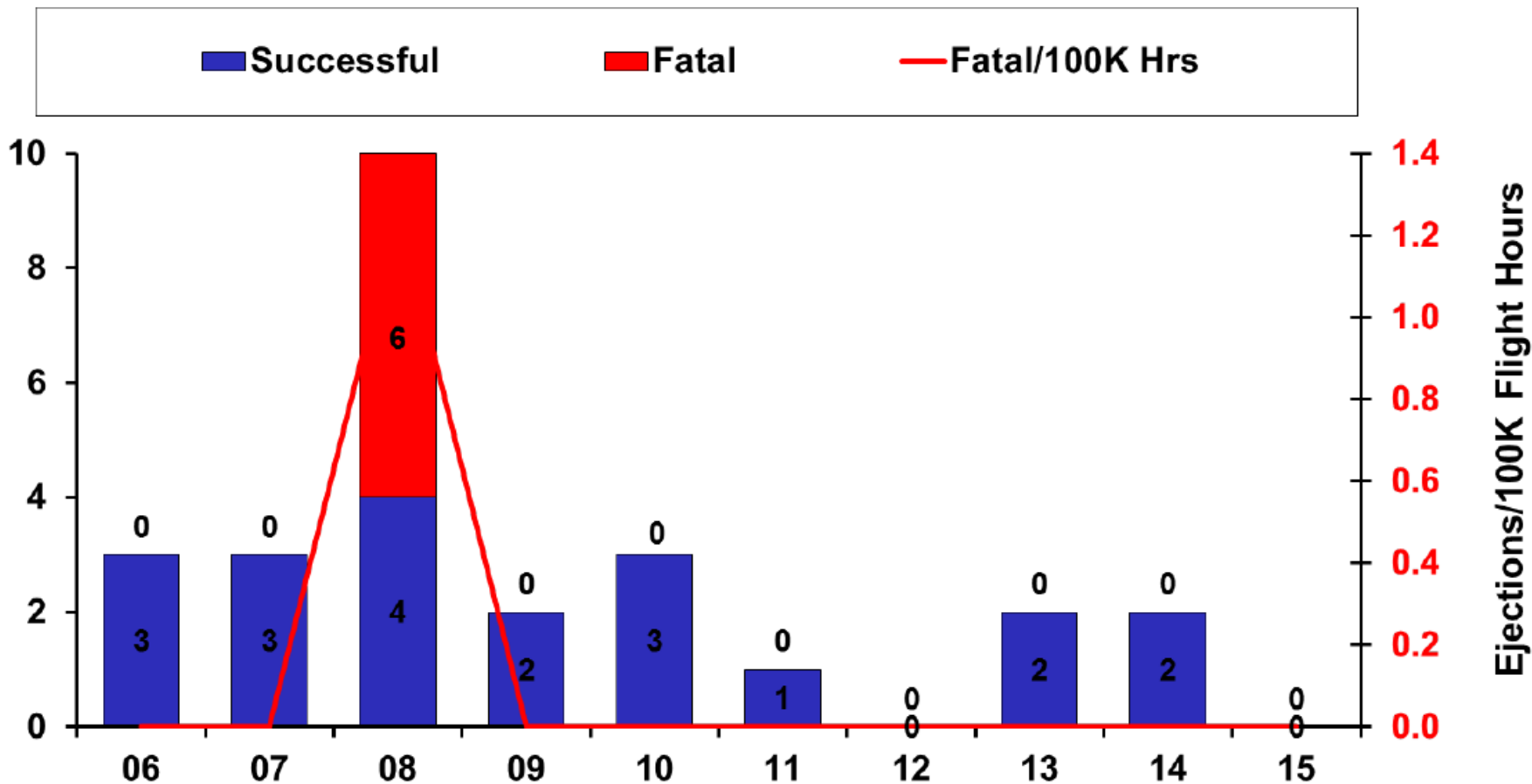
ACES II Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (thru FY15):</i>	472 / 2.02	41 / 0.18
<i>10-Year (FY 06 - 15):</i>	54 / 1.04	4 / 0.08

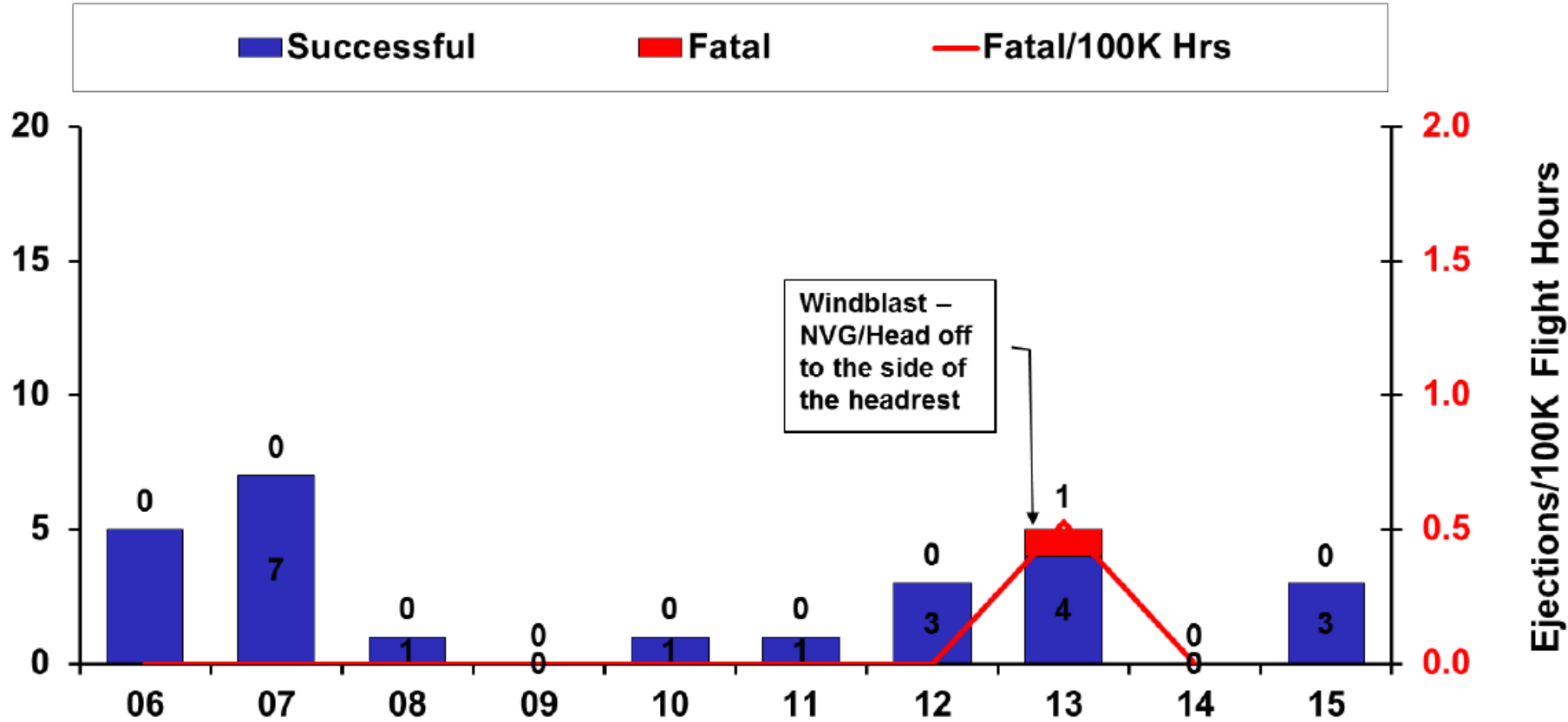


Non ACES Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
10-Year (FY 06 - 15):	26 / 0.82	6 / 0.19

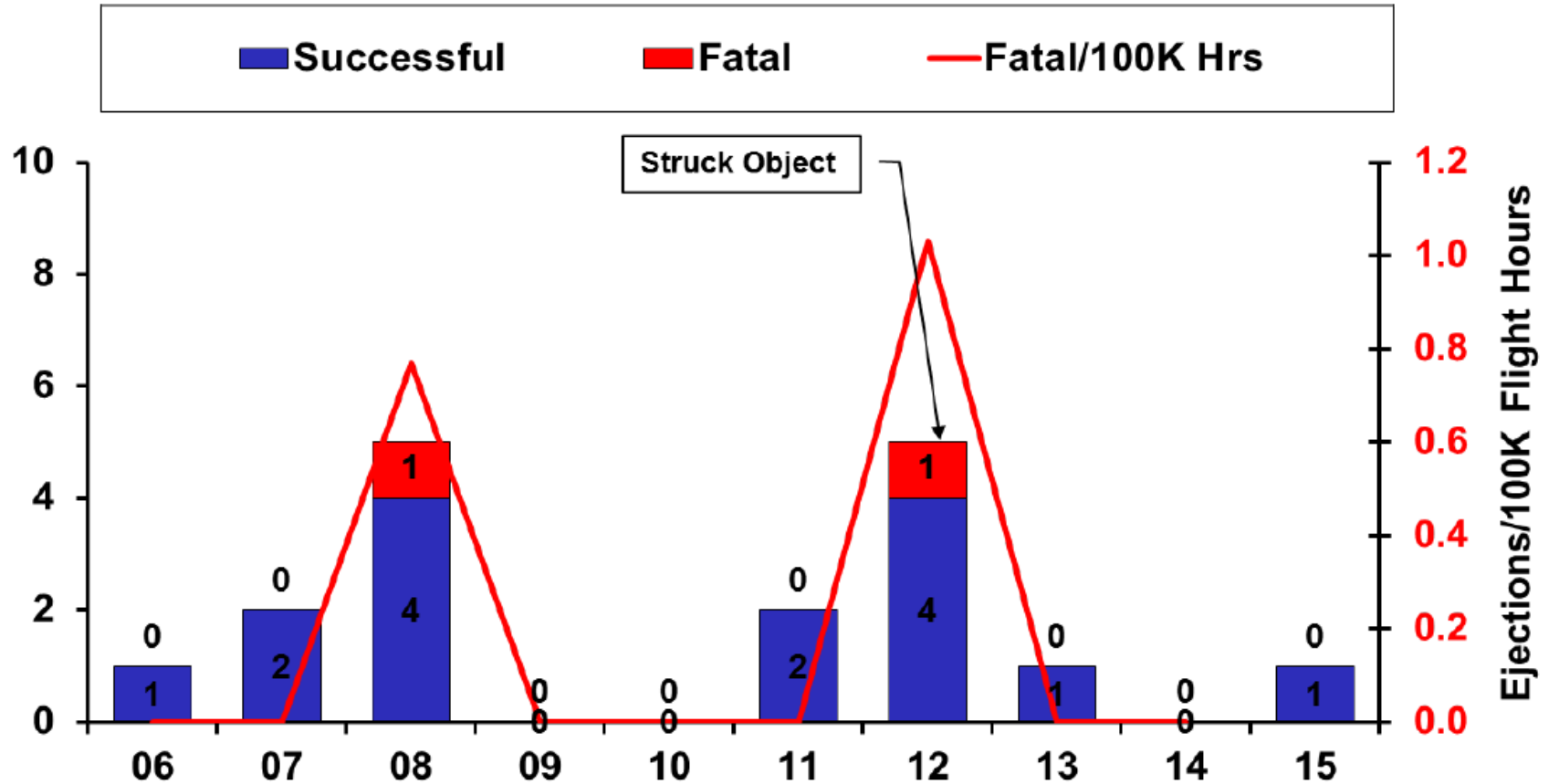
F-16 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (Aug 78-FY15)</i>	297 / 2.83	21 / 0.20
<i>10-Year (FY 06 - 15):</i>	26 / 1.06	1 / 0.04

F-15 Aircraft Ejections

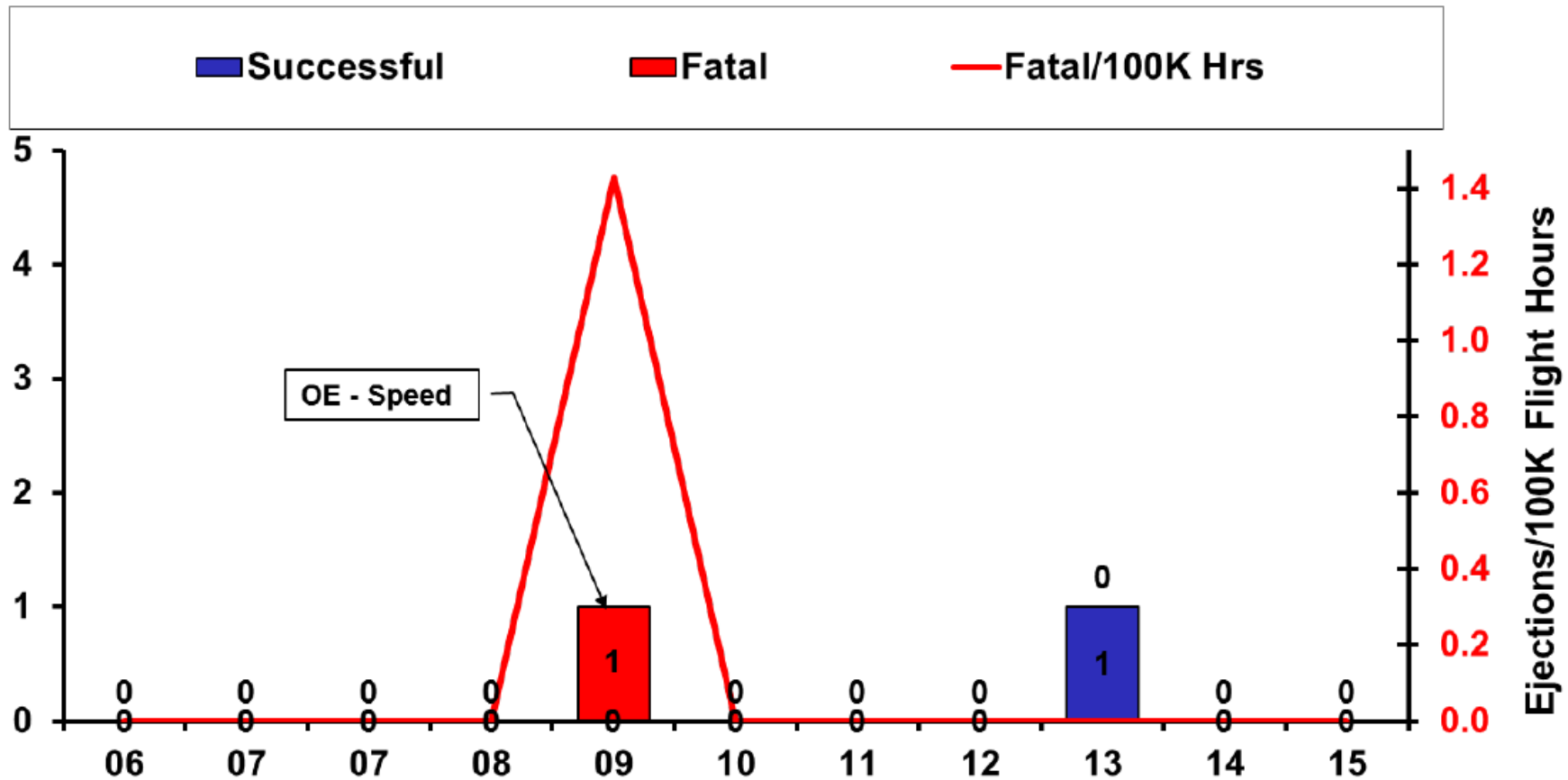
FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (Aug 78 – FY15)</i>	89 / 1.42	8 / 0.13
<i>10-Year (FY 06 - 15):</i>	17 / 1.40	2 / 0.16

F-22 Aircraft Ejections

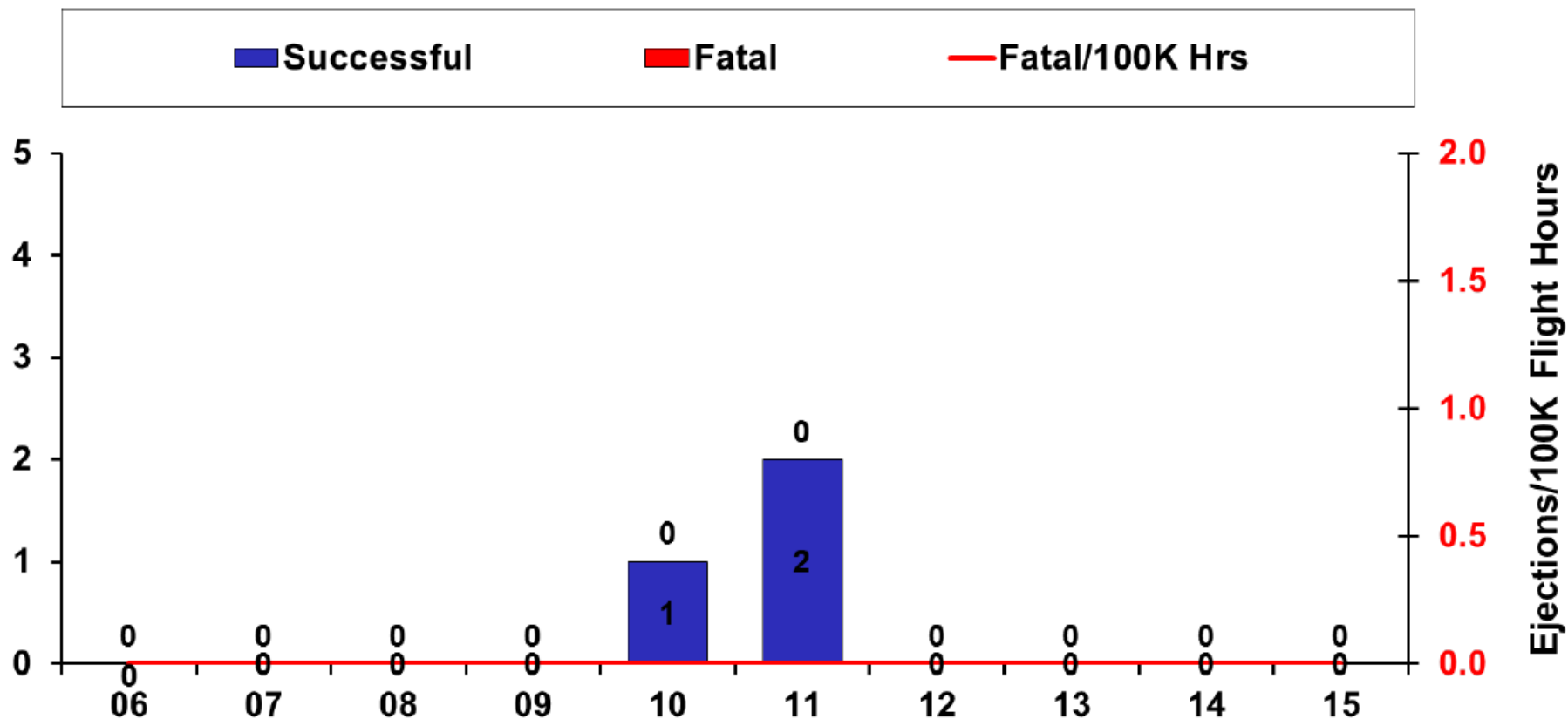
FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (FY02 – FY15):</i>	3 / 1.34	1 / 0.45
<i>10-Year (FY 06 - 15):</i>	2 / 0.92	1 / 0.46



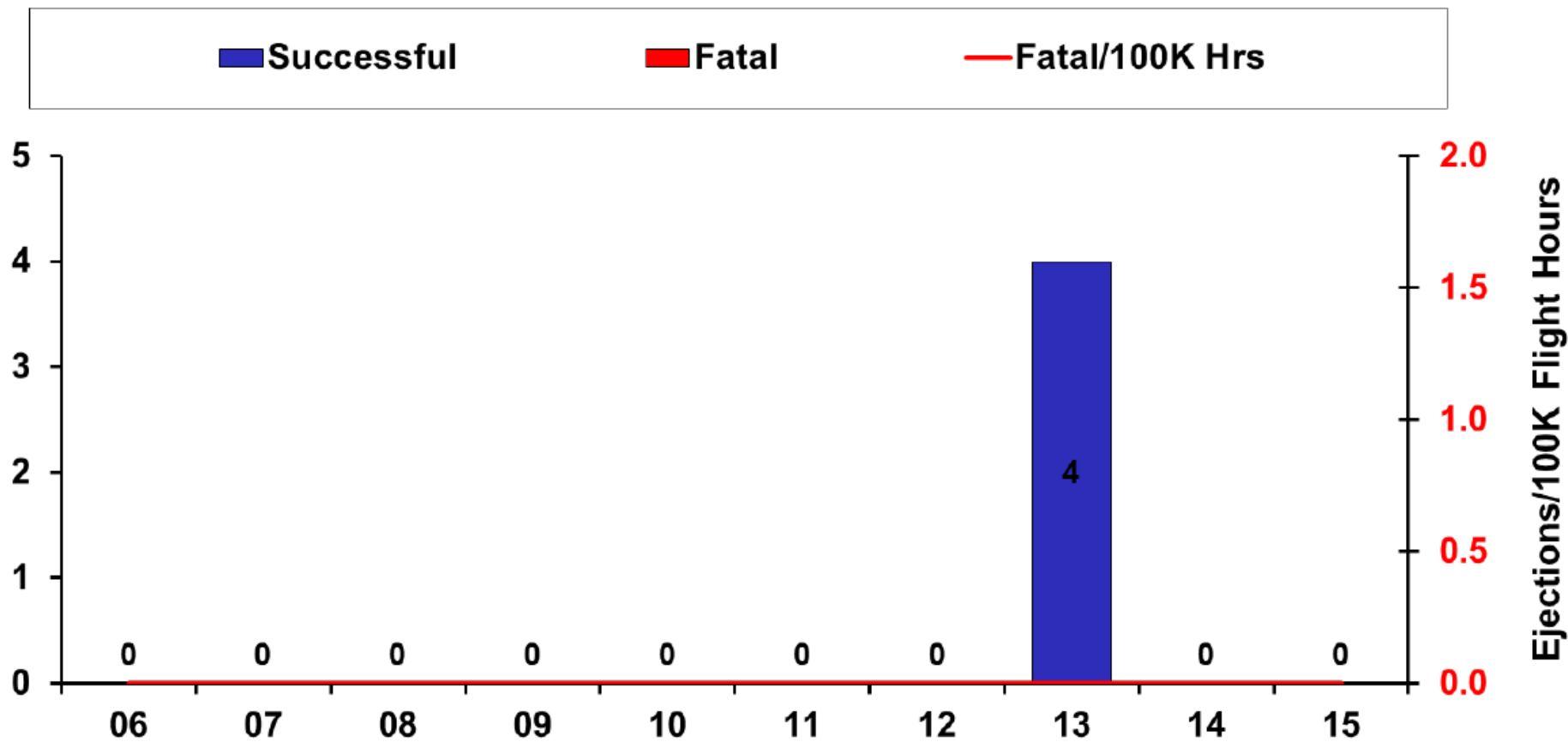
A-10 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (Aug 78 – FY15):</i>	55 / 1.04	10 / 0.19
<i>10-Year (FY 06 - 15):</i>	3 / 0.31	0 / 0.00



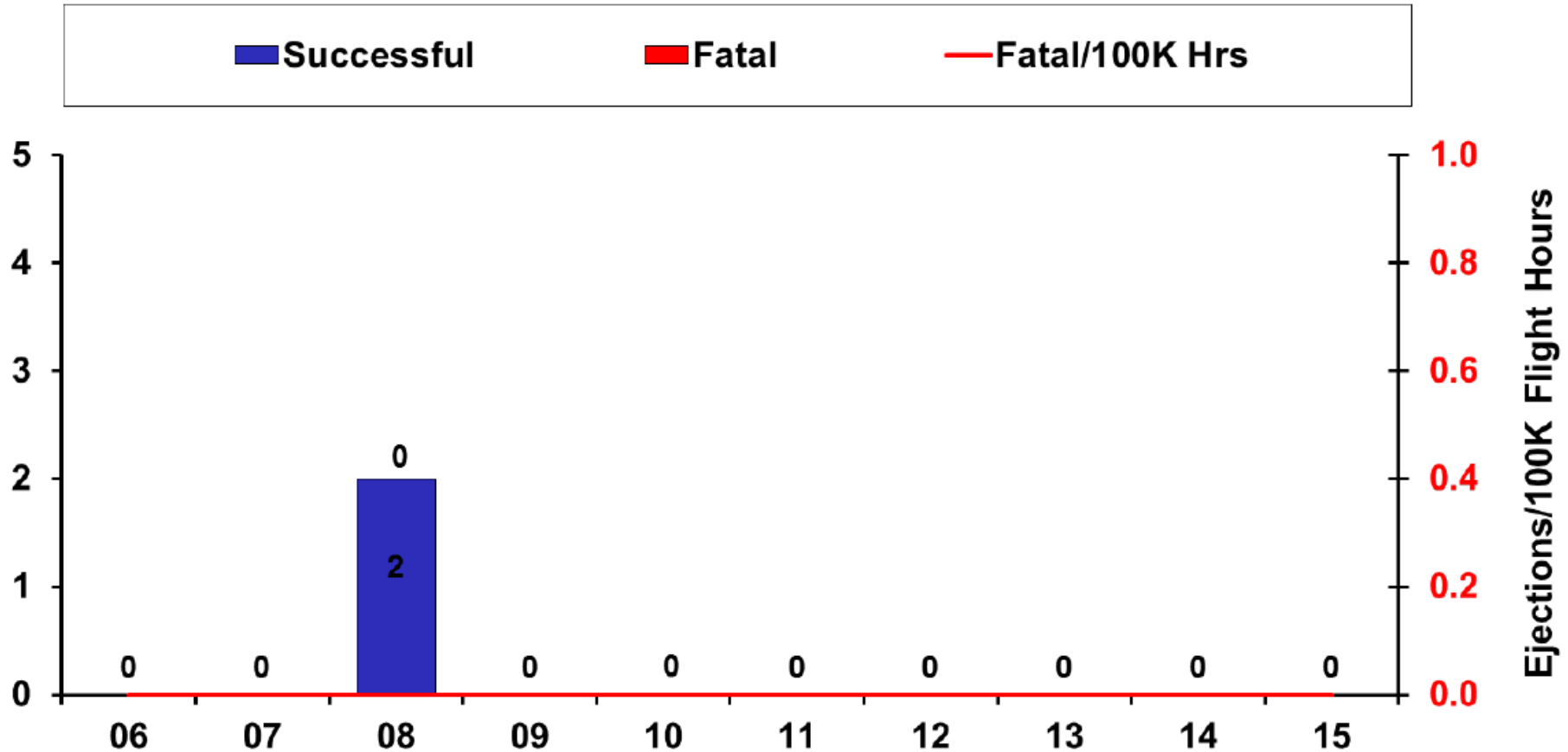
B-1 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (CY84 thru FY15):</i>	<i>24 / 3.44</i>	<i>1 / 0.14</i>
<i>10-Year (FY 06 - 15):</i>	<i>4 / 1.72</i>	<i>0 / 0.00</i>



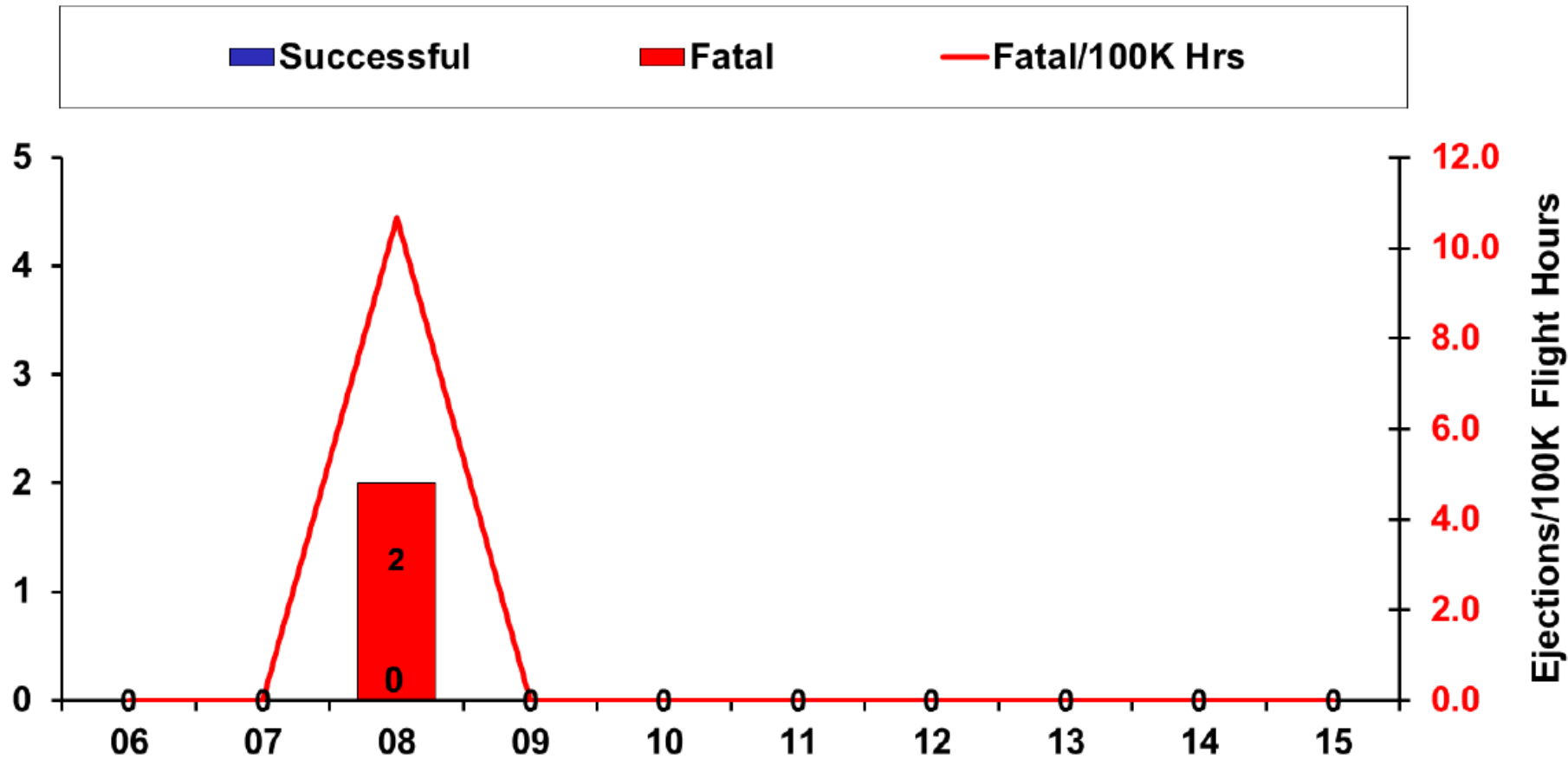
B-2 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (FY90 thru FY15):</i>	2 / 1.70	0 / 0.00
<i>10-Year (FY 06 - 15):</i>	2 / 3.34	0 / 0.00



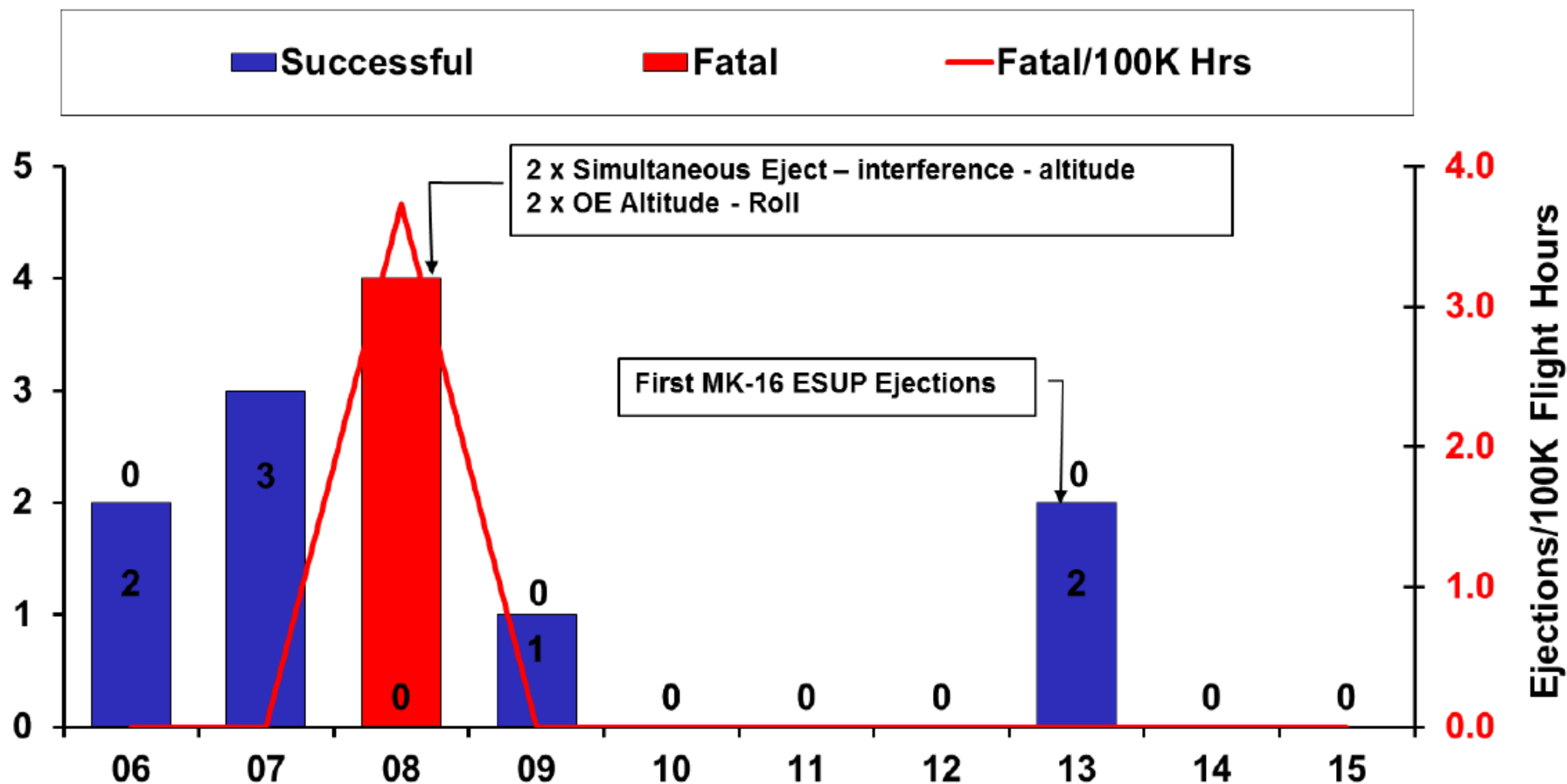
B-52 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
10-Year (FY 06 - 15):	2 / 1.08	2 / 1.08

T-38 Aircraft Ejections

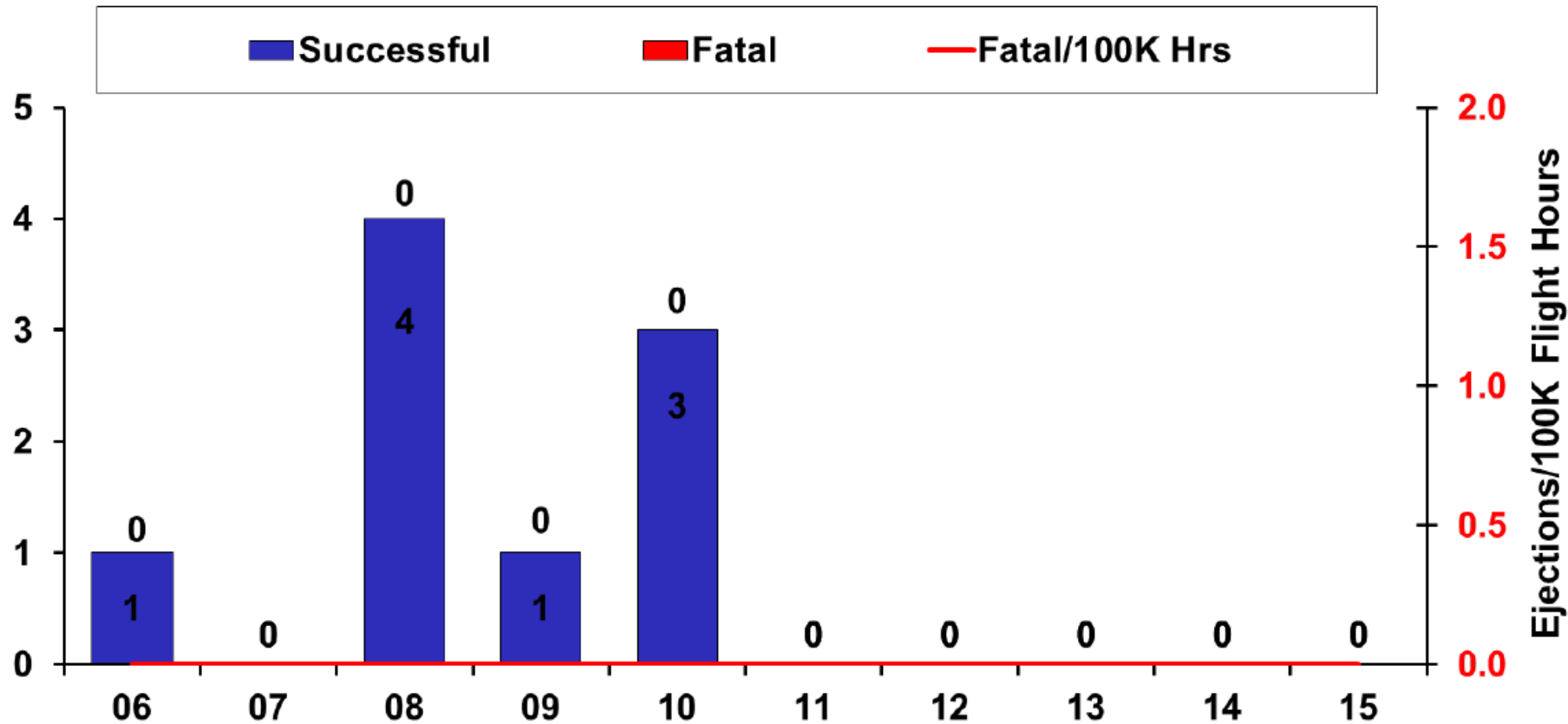
FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
10-Year (FY 06 - 15):	12 / 1.18	4 / 0.38



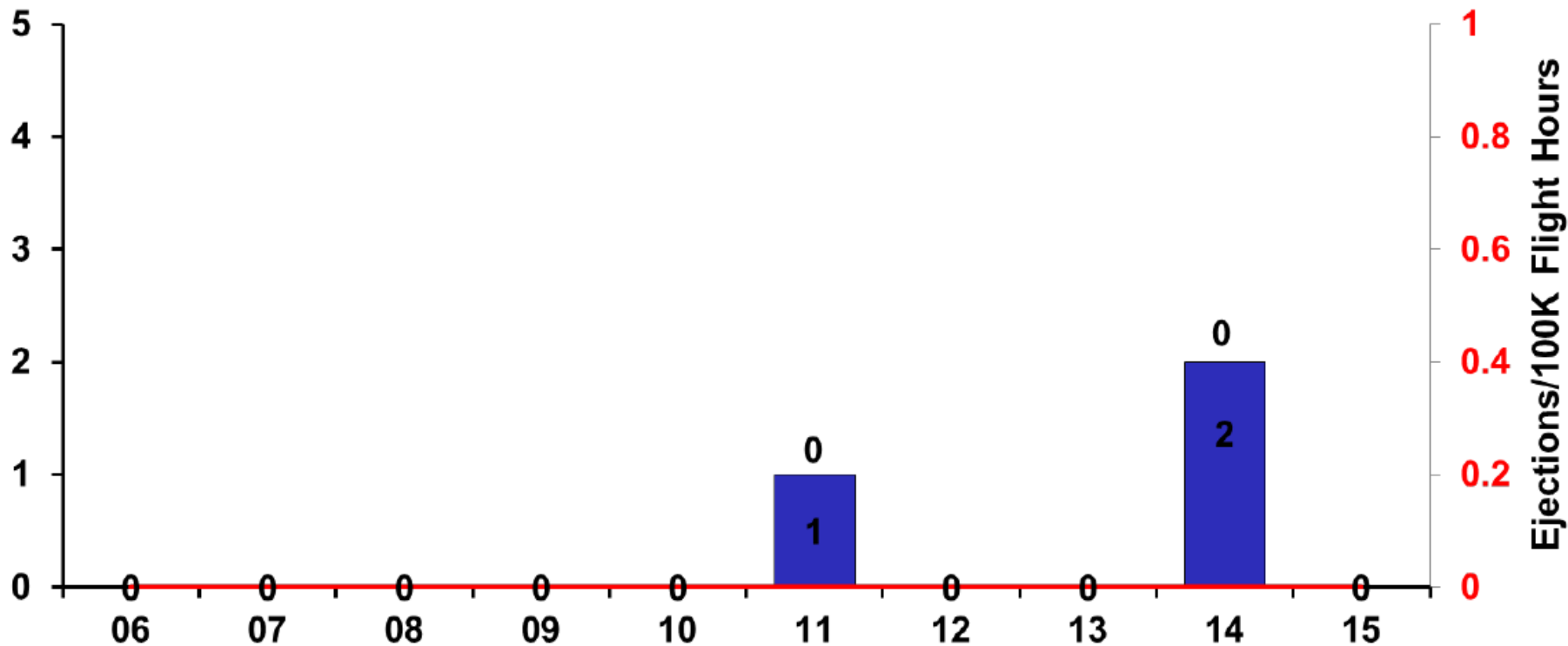
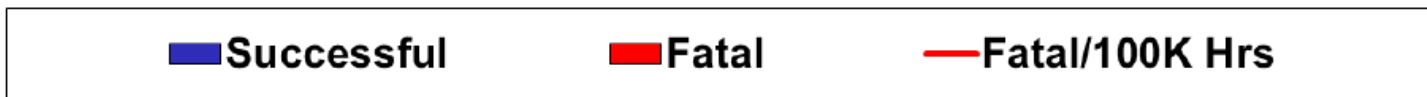
T-6 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
<i>Lifetime (FY00 thru FY15):</i>	12 / 0.66	1 / 0.06
<i>10-Year (FY 06 - 15):</i>	9 / 0.57	0 / 0.00



QF-4 Aircraft Ejections FY 06 – FY 15



	<i>Ejections / Rate</i>	<i>Fatal / Rate</i>
10-Year (FY 06 - 15):	3 /	0 /



Airspeed ACES II Only

8 Aug 78 to Present

Airspeed	Ejections Total	Percent of Total	Fatal Injuries	Percent Fatal Injuries	Major Injuries	Percent Major Injuries
0 - 49	9	2%	0	0%	0	0%
50 - 99	47	10%	4	9%	4	9%
100 - 149	74	16%	0	0%	7	9%
150 - 199	128	27%	1	1%	11	9%
200 - 249	86	18%	9	10%	2	2%
250 - 299	40	8%	2	5%	4	10%
300 - 349	27	6%	3	11%	6	22%
350 - 399	16	3%	5	31%	2	13%
400 - 449	18	4%	2	11%	5	28%
450 - 499	9	2%	4	44%	3	33%
500 - 549	9	2%	3	33%	4	44%
550 - 599	3	1%	3	100%	0	0%
600+	8	2%	5	63%	3	38%
Total	473		41	9%	51	11%



Recent Ejections

F-16C Holloman (FY 16)

MDS:	F-16C
One Liner:	Loss of engine thrust
Occupant:	Pilot, Age 24, Weight 187 lbs
Parameters:	440 feet AGL, 132 KIAS, descending, wings XX, Mode 1
Equipment Issues:	<ol style="list-style-type: none">1. DRS download successful, anomalous data from Z-axis accelerometer, unknown cause.2. Evidence of skidding on seat rollers.3. 25 - 30 kt winds drug pilot 210 feet post PLF.4. HGU-55/P JHMCS Helmet, scars on the back from dragging. Nape strap was found rolled, right visor tang broken. Multiple electrical pins inside JHMCS DU bent.5. Auxiliary kit ripped out of survival kit during dragging.6. URT-44 functioned normally.7. UWARS BIT checked okay.



Recent Ejections

F-16C Spangdahlem (FY 15)

MDS:	F-16C
One Liner:	Loss of engine thrust
Occupant:	Pilot, Age 27, Weight 160 lbs
Parameters:	527 feet AGL, 156 KIAS, descending, wings level, Mode 1
Equipment Issues:	<ol style="list-style-type: none">1. DRS downloaded successfully. MCU-3 data corrupt, sFlash failed post ejection test, unknown cause.2. HGU-55/P JHMCS Helmet: minor crack left side, nape strap not properly fit. Minor dirt and scratches on nose of visor.3. URT-44 functioned normally.4. Minor documentation errors on inspection paperwork (no date/signature).5. UWARS/batteries removed, could not be tested.6. Four line release deployed.



Recent Ejections

F-16C Shaw (FY 15)

MDS:	F-16C
One Liner:	Mid-air collision w/civilian aircraft, lost thrust
Occupant:	Pilot, Age 34, Weight 235 lbs
Parameters:	270 feet AGL, 180 KIAS, wings level, descending Mode 1
Equipment Issues:	<ol style="list-style-type: none">1. Wearing JHMCS, HVI cable QD unnecessarily disconnected2. Inertia reel straps not fully retracted (4 – 5 inch extended), large occupant stature.3. Mask found connected to CRU-120/P and both bayonet receivers.4. LRU-16/P life raft CO2 coupling nut found finger tight5. URT-44 worked properly.



Recent Ejections

F-16C Tulsa (FY 15)

MDS:	F-16
One Liner:	Mid-air collision
Occupant:	Pilot, Age 41, Weight 185 lbs
Parameters:	7,000 feet AGL, 0 KIAS, out of control
Equipment Issues:	<ol style="list-style-type: none">1. DRS had two internal failures:<ol style="list-style-type: none">a) Power-on-reset of Microprocessor Control Unit (MCU) 1b) "Noise" in MCU 3 put it in non-participating test modeThese two failures resulted in not firing drogue gun, drogue severance cutters, primary parachute mortar cartridge, and harness release cartridge.2. DRS accelerometer data indicates back up handle was pulled 3 – 4 seconds after DRS start switch3. JHMCS worn.



Recent Ejections

F-15D Lakenheath (FY 15)

MDS:	F-15D
One Liner:	Pilot loss of control in-flight
Occupant:	Pilot, Age 28, Weight 212 lbs. Fwd seat
Parameters:	5,600 feet AGL, 21 KIAS (flat spin), Mode I, Solo, -10,800 ft/min descent, 91 deg/sec yaw
Equipment Issues:	<ol style="list-style-type: none">1. DRS Data Received2. URT-44, FWD and AFT Activated automatically3. MBU-20/P and CRU-94/P discarded during descent4. Twisted risers, forced head down during parachute opening5. Survival kit entangled legs while "bicycle kicking" to untwist6. Visor blown back on helmet7. 4 line release successfully utilized8. Flight gloves found in right G-suit leg pocket, modified by cutting tips off fingers



Recent Ejections

QF-4C Tyndall (FY 14)

MDS:	QR-F4C
One Liner:	Hydraulic failure, missed cable, ejection as aircraft departed the prepared surface, Class C
Occupant:	Pilot (front, second out), Age 42, Weight 215 lbs
Parameters:	0 feet AGL, 110 KIAS, initiated command ejection w/lower handle
Equipment Issues:	<ol style="list-style-type: none">1. Pressure operated initiator (POI) ruptured. Reddish brown fluid at lower section of line. Hypothesized that residual hydraulic fluid in the line could have been vaporized and ignited when cartridge fired leading to high internal pressure/rupture.2. 3 leg restraints released the shear ring as designed, one tore the anchor assembly and some structure off the cockpit floor and did not break the shear ring. The cockpit floor had significant corrosion in the anchor attachment area.



Recent Ejections

QF-4C Tyndall (FY 15)

MDS:	QR-F4C
One Liner:	Hydraulic failure, missed cable, eject as aircraft departed prepared surface, Class C
Occupant:	Test Engineer (rear, first out), Age 37, Weight 184 lbs
Parameters:	0 feet AGL, 110 KIAS
Equipment Issues:	1. 4 UWARS tested, 2 fired in 2 seconds or less, 2 fired in 4 seconds. Recent rain may have diluted the salinity/conductivity of the water from the Gulf used for the test



Recent Ejections

B-1B Ellsworth (FY 13)

MDS:	B-1B
One Liner:	In-flight fire, loss of control
Occupant:	OSO (right rear, first out), Age 29, Weight 155 lbs.
Parameters:	7600 feet AGL, 410 KIAS, Mode II, out of control
Equipment Issues:	<ol style="list-style-type: none">1. DRS S/N 0757 successfully downloaded by Teledyne.<ul style="list-style-type: none">-Significant accelerations in all three axes at drogue correction, with lateral reaching +28g, indicating right seat yaw. Each subsequent ejection recorded progressively higher lateral acceleration in same direction.-Divergence inhibit switch position had some chatter but correctly selected inhibit at start switch activation2. Complete analysis of Environmental sensor pending3. Helmet lost



Recent Ejections

B-1B Ellsworth (FY 13)

MDS:	B-1B
One Liner:	In-flight fire, loss of control
Occupant:	DSO (left rear, second out), Age 36, Weight 211 lbs.
Parameters:	7600 feet AGL, 410 KIAS, Mode II, out of control
Equipment Issues:	<ol style="list-style-type: none">1. DRS S/N 0750 successfully downloaded by Teledyne.<ul style="list-style-type: none">-Significant accelerations in all three axes at drogue correction, with lateral reaching +32g, indicating right seat yaw.-Divergence inhibit switch position had significant chatter but correctly selected inhibit at start switch activation2. Helmet lost.



Recent Ejections

B-1B Ellsworth (FY 13)

MDS:	B-1B
One Liner:	In-flight fire, loss of control
Occupant:	Co-Pilot (third out), Age 34, Weight 185 lbs.
Parameters	7600 feet AGL, 410 KIAS, Mode II, out of control
Equipment Issues:	<ol style="list-style-type: none">1. DRS S/N 0726 successfully downloaded by Teledyne. -Significant accelerations in all three axes at drogue correction, with lateral reaching +38g, indicating right seat yaw.2. Left leg restraint not properly routed through roller, pulled backward through snubber 1 3/4 inch by leg flail .3. Both leg restraints had an improper, lower strength aluminum shear rivet installed. Right leg restraint only partially retracted 7 3/8 inch, due to low strength shear rivet.

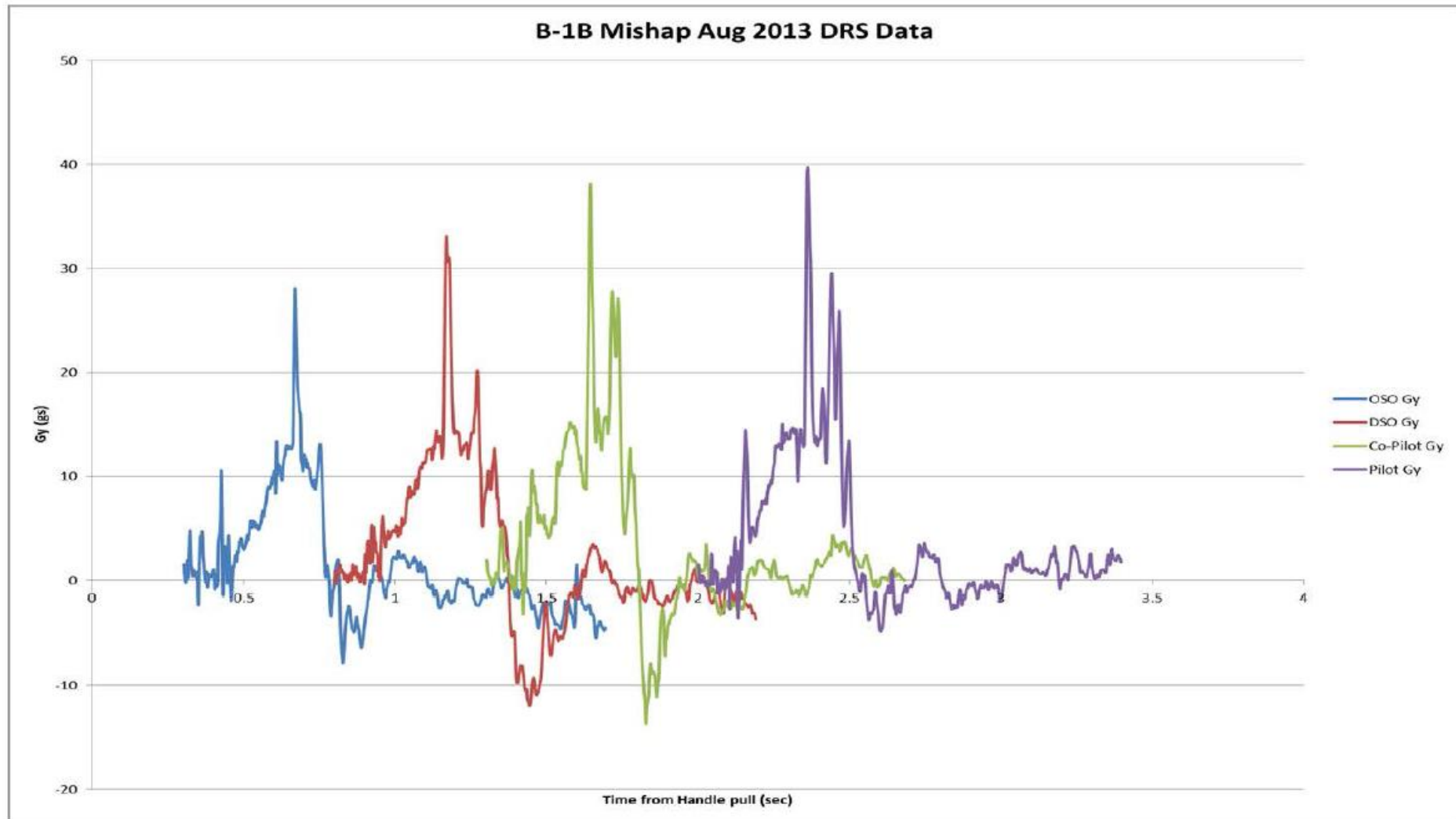


Recent Ejections

B-1B Ellsworth (FY 13)

MDS:	B-1B
One Liner:	In-flight fire, loss of control
Occupant:	Pilot (last out), Age: 30 Weight: 176 lbs.
Parameters:	7600 feet AGL, 410 KIAS, Mode II, out of control
Equipment Issues:	<ol style="list-style-type: none">1. DRS S/N 0741 successfully downloaded.<ul style="list-style-type: none">-Environmental sensor speed switch open from power up-Significant accelerations in all three axes at drogue correction, with lateral reaching +40g, indicating seat yawed right.2. Left leg restraint not properly routed through roller, resulting in very little retraction - 1 7/8 inch.3. 3. Both leg restraints had an improper, lower strength aluminum shear rivet installed. Right leg restraint only partially retracted 11 5/8 inch, due to low strength shear rivet.

Ejection Concerns - Accelerations





Ejection Concerns

- **Seat Accelerations in Mode II ejections**
 - **Significant at drogue snatch**
 - **Possibly aircraft induced seat motion**
 - **Exacerbated by loose lap belts/equipment**
 - **Lateral acceleration – particularly high – seat yaw**
- **Too many preventable flail injuries**
- **Environmental Sensor Switch Chatter**
- **Equipment wear & training**
- **Roller Friction**



Recommendations

- **SSIP-Safety and Sustainability Improvement Program**
- **Fast Drogue – improve seat stability**
- **Head and neck restraint**
 - **Especially needed for small occupants**
 - **Especially needed for Helmet Mounted Display**
- **Limb Restraints**
- **ES – Switch Chatter**
 - **Need MASS**
 - **Need filtering/selection criteria**
 - **Need pop-up airstream pitot tubes**
- **Need improved “frictionless” rollers**

Injury Definitions

AFR 127-4, "Investigating and Reporting US Air Force Mishaps", and are detailed in the following paragraphs.

Fatal Injury or Occupational Illness: One that results in death in the mishap, or due to complications arising there from. The latter applies regardless of the time between the injury or illness and death.

Major Injury or Occupational Illness: A nonfatal injury or illness requiring admission to a hospital or quarters, or a combination of both, for 5 or more days. It also includes any of the following, regardless of hospital status:

- (1) Unconsciousness for more than 5 minutes due to head trauma.***
- (2) Fracture or any bone, except simple fracture of the nose or phalanges.***
- (3) Traumatic dislocation of major joints or internal derangement of a knee.***
- (4) Moderate to severe lacerations resulting in severe hemorrhage or requiring extensive surgical repair.***
- (5) Injury to any internal organ.***
- (6) Any third degree burns, or any first or second degree burns (including sunburn) over 5 percent of the body surface.***

Minor Injury or Occupational Illness: An injury or illness less than major which:

- (1) Requires military personnel to be admitted to a hospital or quarters, or a combination of both, for at least 1 day but no more than 4 days; or***
- (2) Results in a loss of regular working time for civilians beyond the day or shift on which the injury or illness occurs; or***
- (3) Is a simple fracture of the nose or phalanges.***

No Injury: Any injury less than minor. NOTE: Hospitalization for observation only, is not classified as an injury or illness."



Questions?