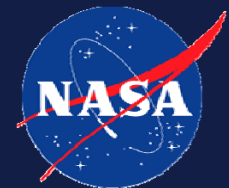




ASRS Reports on Wake Vortex Encounters

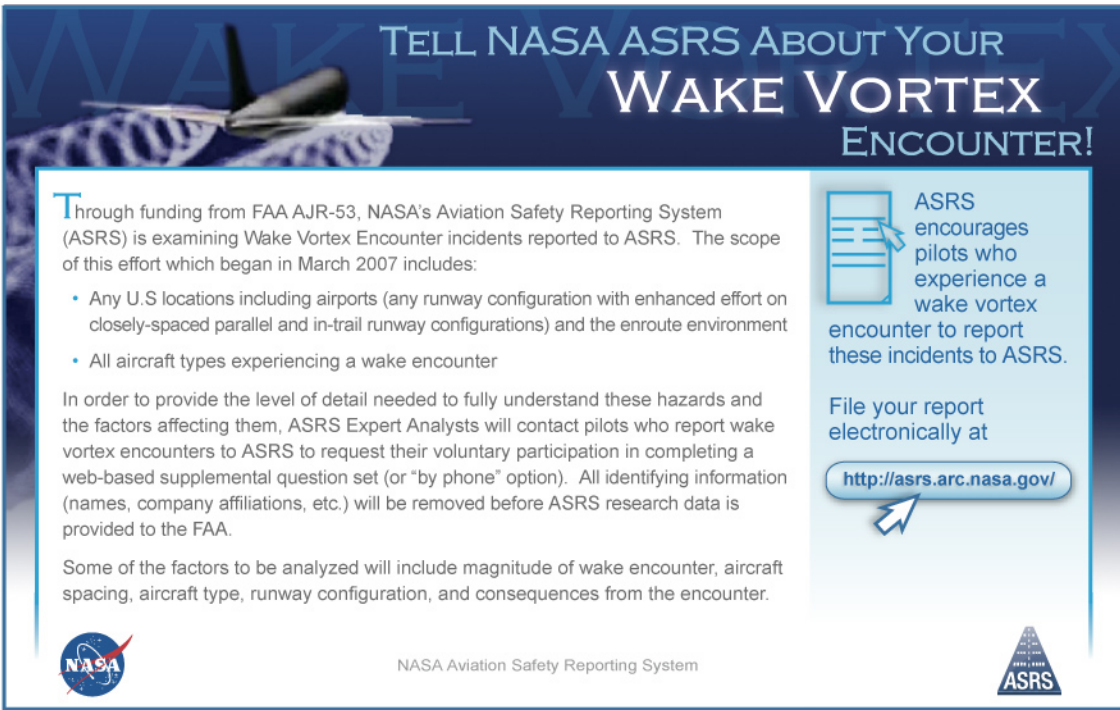
WakeNet USA
October 20 & 21, 2010



Wake Vortex Reporting to ASRS

▶ 199 reports received to date

- 129 Structured Callbacks completed through Oct 1 2010
- 29 Structured Callbacks completed since last WakeNet Meeting (March 2010)



TELL NASA ASRS ABOUT YOUR WAKE VORTEX ENCOUNTER!

Through funding from FAA AJR-53, NASA's Aviation Safety Reporting System (ASRS) is examining Wake Vortex Encounter incidents reported to ASRS. The scope of this effort which began in March 2007 includes:

- Any U.S locations including airports (any runway configuration with enhanced effort on closely-spaced parallel and in-trail runway configurations) and the enroute environment
- All aircraft types experiencing a wake encounter

In order to provide the level of detail needed to fully understand these hazards and the factors affecting them, ASRS Expert Analysts will contact pilots who report wake vortex encounters to ASRS to request their voluntary participation in completing a web-based supplemental question set (or "by phone" option). All identifying information (names, company affiliations, etc.) will be removed before ASRS research data is provided to the FAA.

Some of the factors to be analyzed will include magnitude of wake encounter, aircraft spacing, aircraft type, runway configuration, and consequences from the encounter.

ASRS encourages pilots who experience a wake vortex encounter to report these incidents to ASRS.

File your report electronically at <http://asrs.arc.nasa.gov/>

NASA Aviation Safety Reporting System



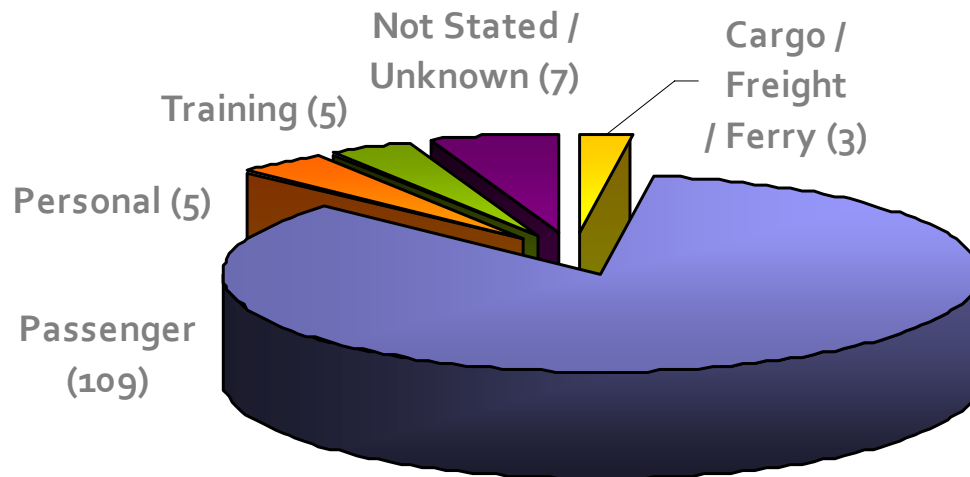
Oct 1, 2010

2



Descriptive Information

- ▶ 129 Unique Events – August 2007 to Oct 1, 2010
 - 1 Supplemental Question Set completed for each event
- ▶ Majority Air Carrier Operations (n=95)
 - Remaining were Air Taxi, Corporate, FBO, Fractional, and Personal
- ▶ Majority were passenger operations (n=109) [see Figure]
- ▶ There were 11 events reported by pilots of single-crew aircraft, 114 by pilots of multi-crew aircraft



Oct 1, 2010



Flight Segment at Wake Encounter

▶ Flight Segment

Wake Encounter Aircraft

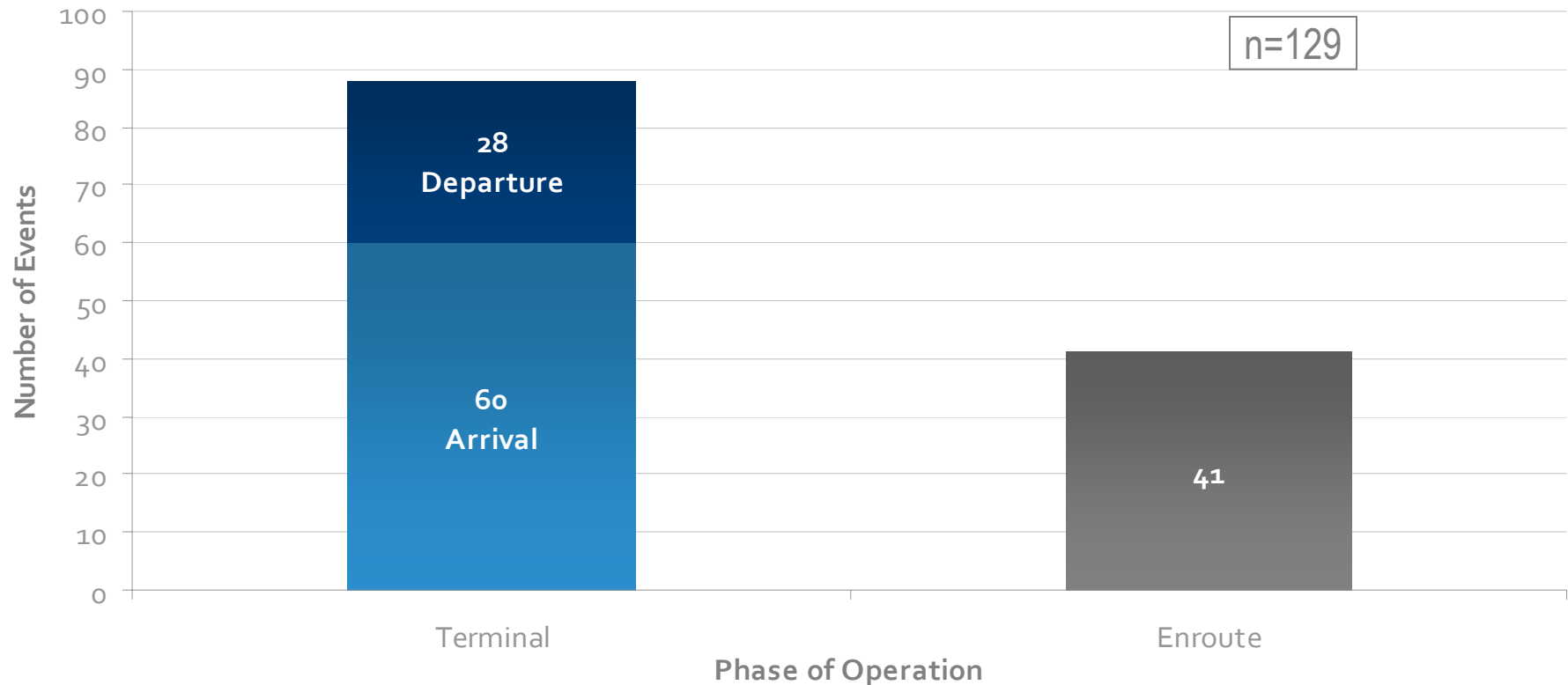
- 88 in Terminal Area
 - 60 on Arrival; 28 on Departure
- 41 Enroute

▶ Runway Change

Wake Encounter Aircraft

Terminal only

3 aircraft received a runway change prior to WVE and 85 did not



Terminal Operations

(88 in Terminal Area: 60 on Arrival & 28 on Departure)



Oct 1, 2010



Terminal Operations ARRIVAL (n=60)



Oct 1, 2010



Airport Information - Arrival

▶ Airport Identifier

- LAX (n=11); ORD (n=6); ATL (n=4); SNA (n=4); SFO= (n=4); CLT (n=3); and others

▶ Distance from Runway

- Within 5 miles (n=31); 7+ Miles (n=25); 10+ Miles (n=21)

▶ Wind Speed

- Majority of the winds were calm (n=13) or light / below 10 knots (n=21).



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Notable Reporter Comments

(A CRJ-701 behind an A320 at 3500 MSL on arrival to CLT)

- ▶ Report Narrative: ...*Being vectored on to the RWY 23 approach in CLT the approach controller put us on and cleared us for the approach 4.5 miles in trail of another a/c. She assigned us 160 kts till LECAR. She handed us over to the tower and that's when the event started, the aircraft started to roll right then left 40 degrees and it got worse for approx. a minute or two. Once we got the a/c under control I called the tower and asked what type of aircraft we were behind. I was told an A320. I informed him that we had been through severe wake turbulence. ... Someone is gonna get killed if something isn't done. I understand the idea of moving the traffic but this is not safe. Maybe the approach controllers should advise of the a/c type ahead and provide at least 5 mile in trail all the way to the runway.*

Additional information from response to SQS C.15: This is becoming more and more common it seems on departure as well as arrival in KCLT. This event was the worst I have yet to experience. 4.5 miles in trail on the approach behind this airbus on a hot calm day was not sufficient space to stay out of the wake.

Additional information from response to SQS C.16: It seems that the A320-321 series a/c produce a lot of wake. There needs to be some criteria similar to the criteria behind B757's for these types of a/c. I am very much concerned that

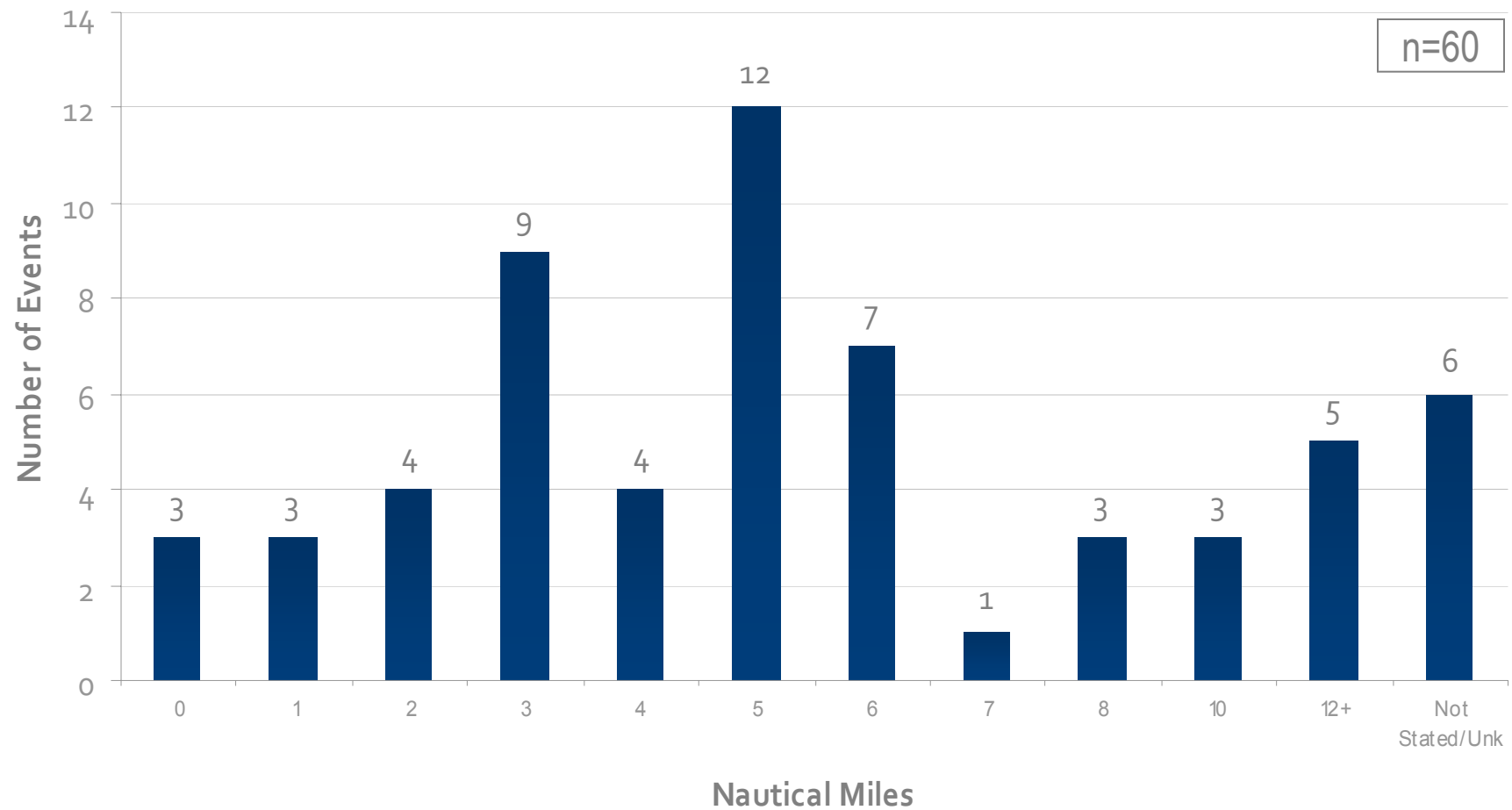
someone will be hurt before criteria is established. –ACN 897674



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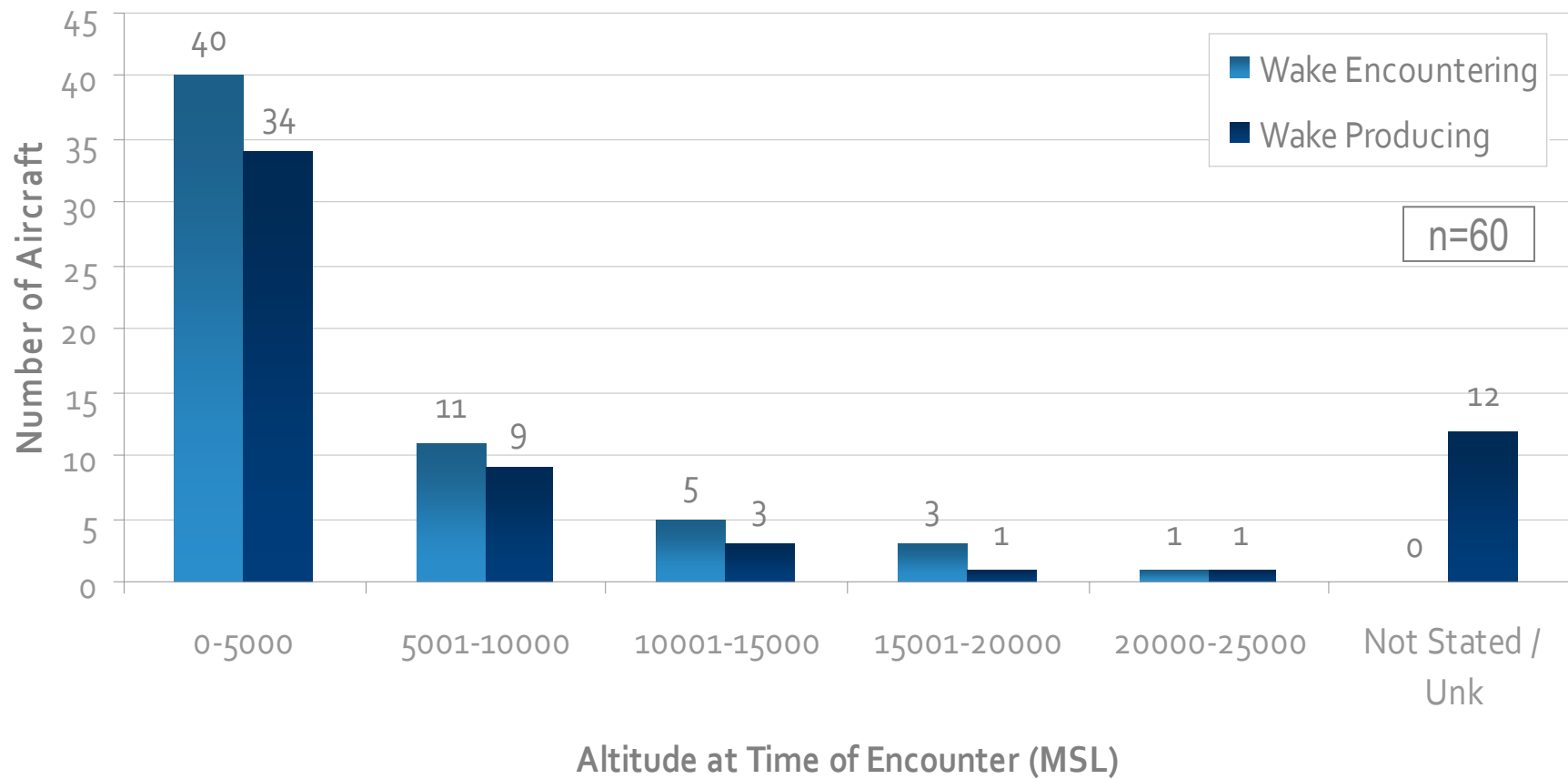
Distance from Wake Producing Aircraft - Arrival



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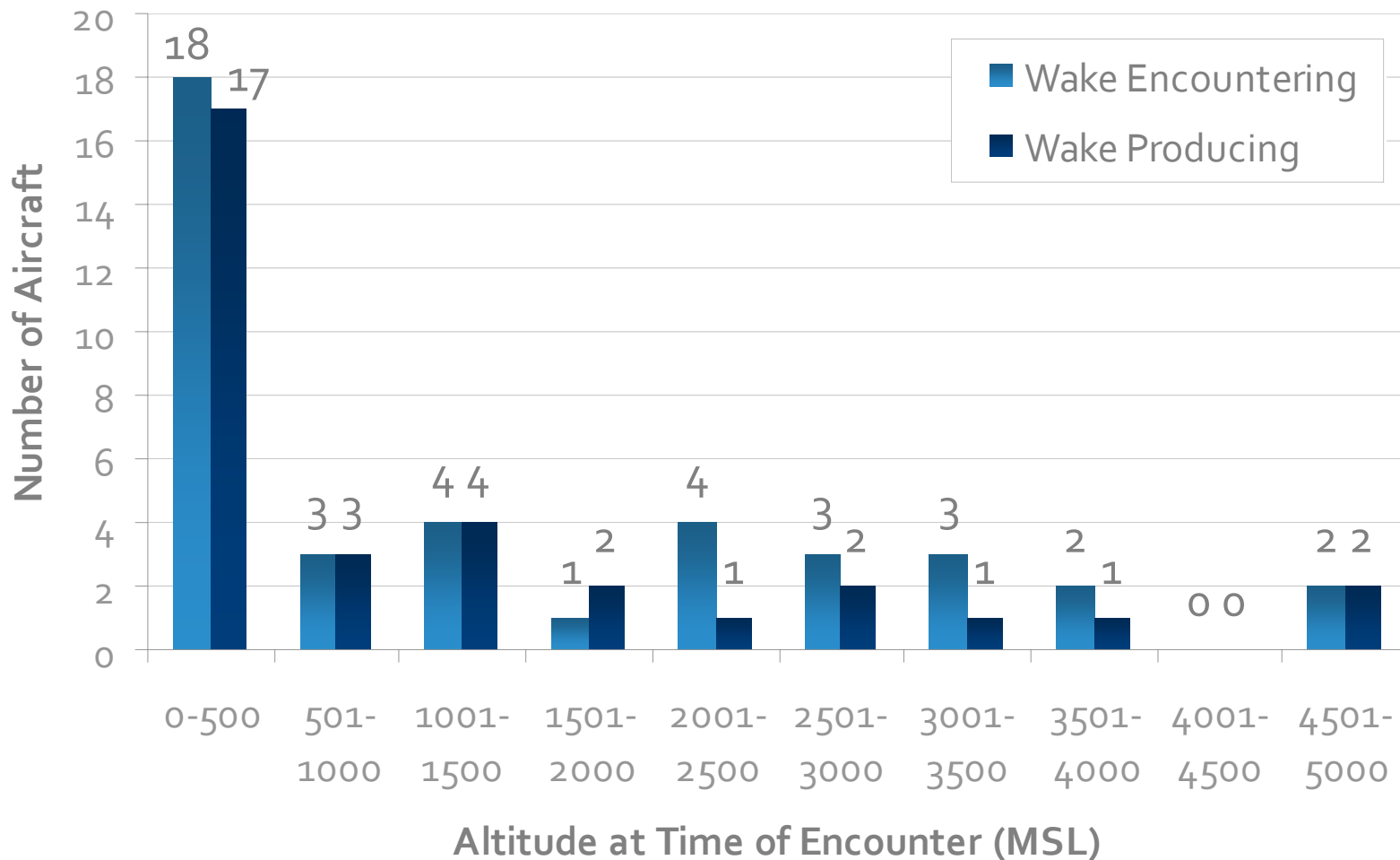
Altitude of Wake Encountering and Wake Producing Aircraft - Arrival



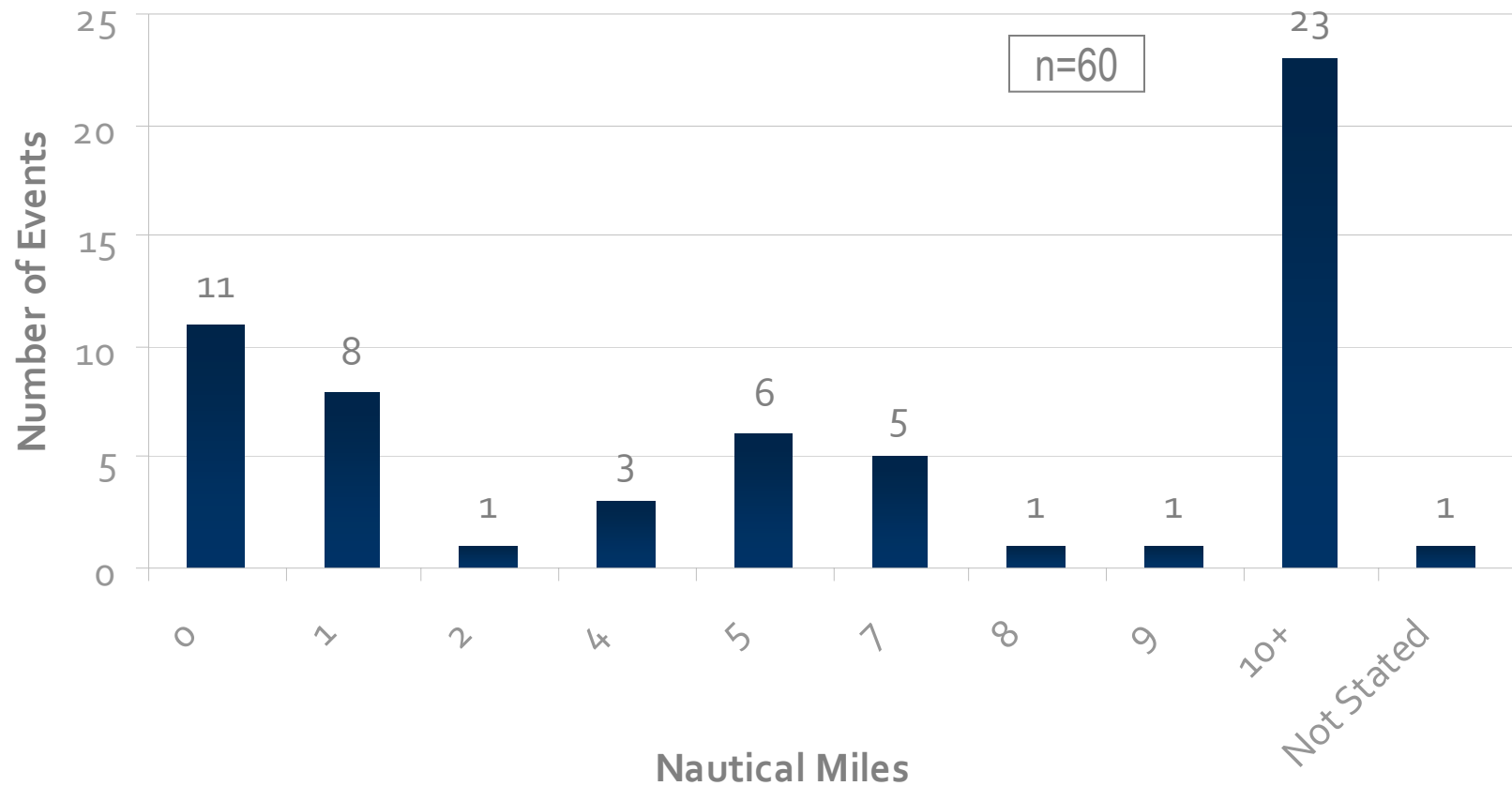
Oct 1, 2010



Altitude of Wake Encountering and Wake Producing Aircraft (0-5000 MSL) - Arrival



Distance from Runway - Arrival



Encounters in Terminal Airspace - Arrival

n=60

		Wake Encountering Aircraft Weight Category					
		Heavy (H)	757	Large (L)	Small (S)	Unknown (U)	Total for Generating Category
Wake Producing Aircraft Weight Category	H	4	1	23	1		29
	757			6	1		7
	L			14	4		18
	S				5		5
	U			1			1
Total for Encountering Category		4	1	44	11		60



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Terminal Operations DEPARTURE (n=28)



Oct 1, 2010



Airport Information - Departure

▶ Airport Identifier

- PHL (n=4), DFW (n=3), LAS (n=4), SNA (n=2), ORD (n=2), ATL (n=2) and others

▶ Wind Speed

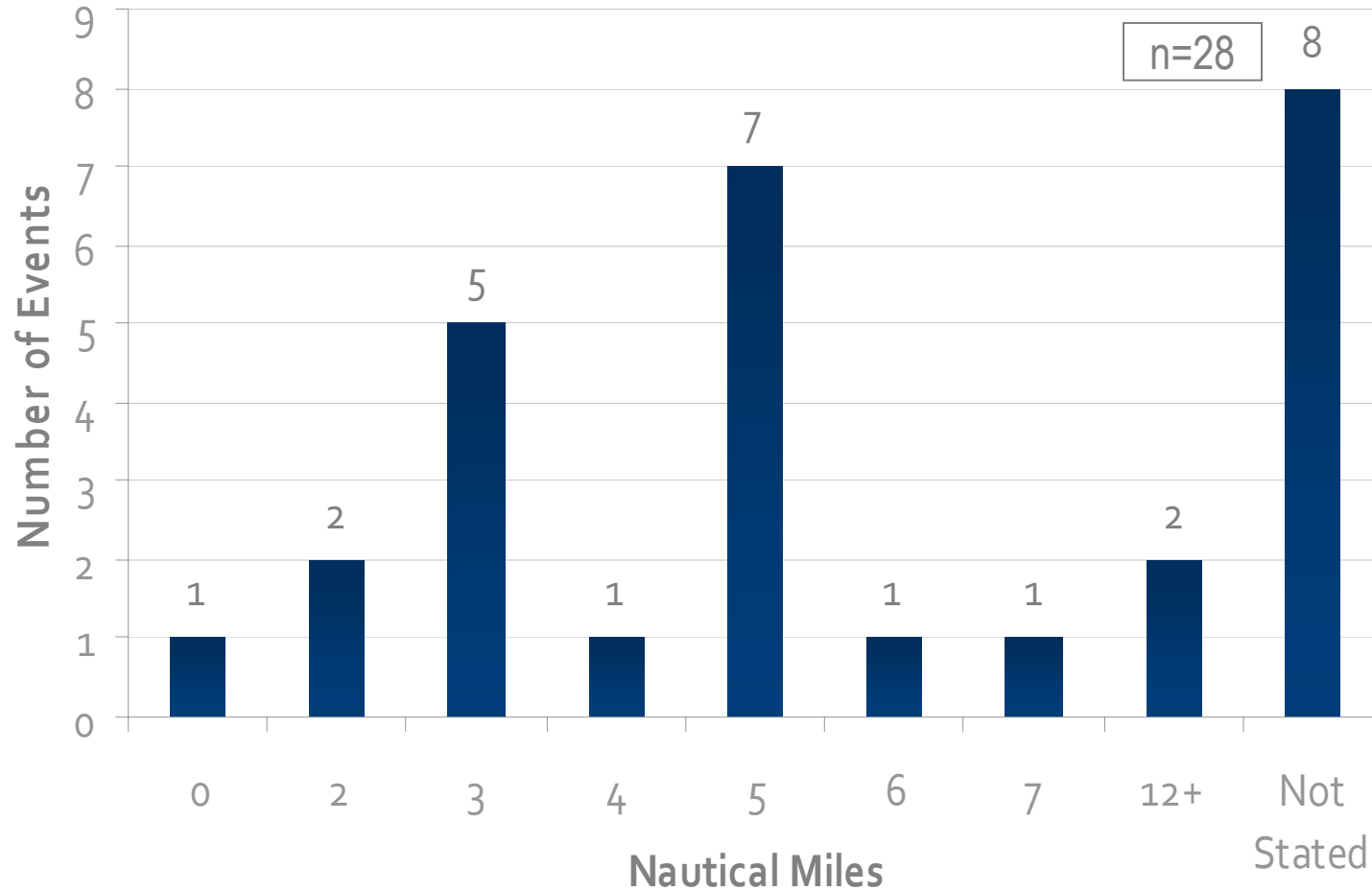
- The majority of the winds (n=9) were under ten knots, light and variable, or calm; however, four pilots reported winds between 15 to 20 knots.



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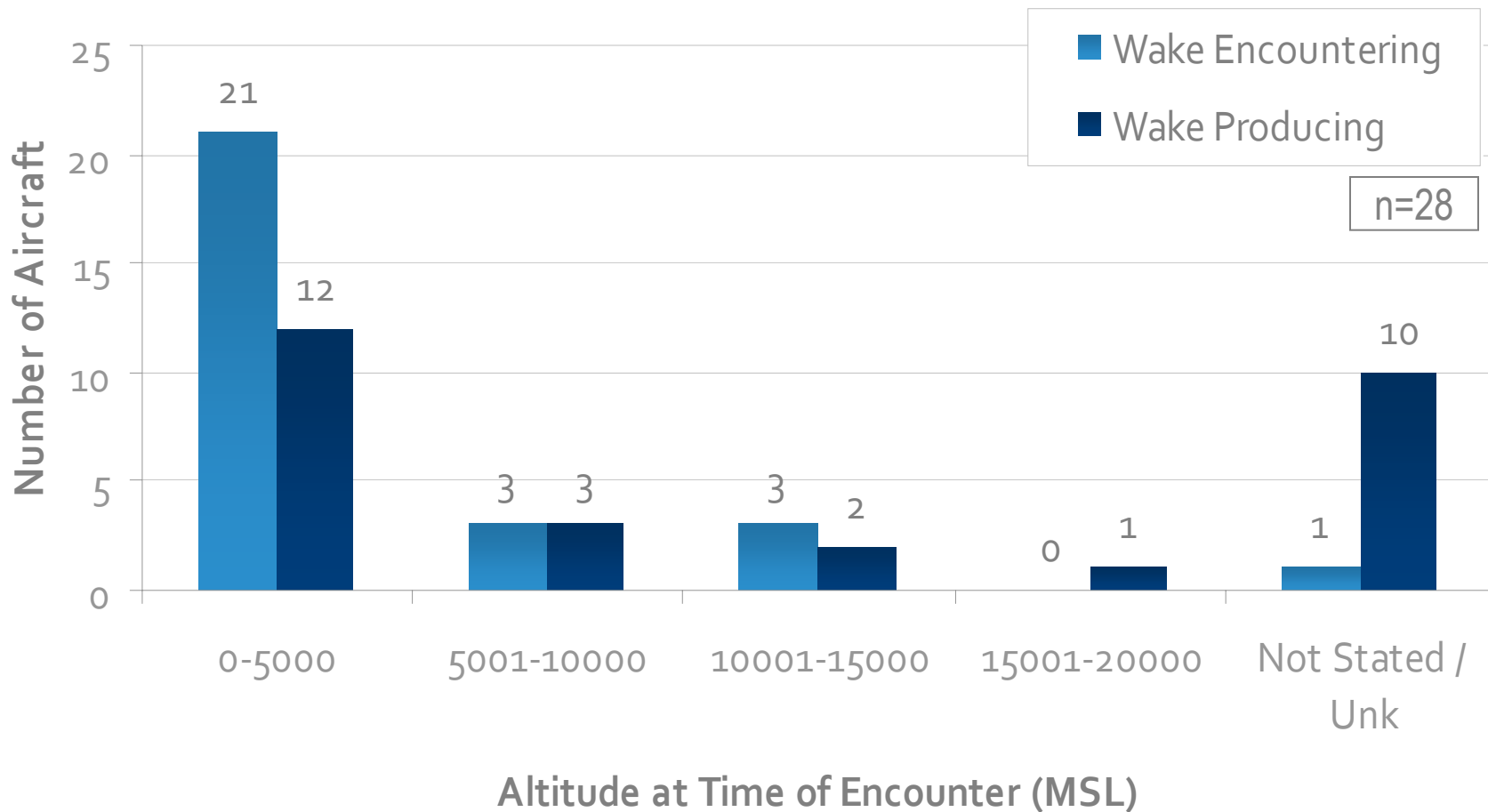
Distance from Wake Producing Aircraft - Departure



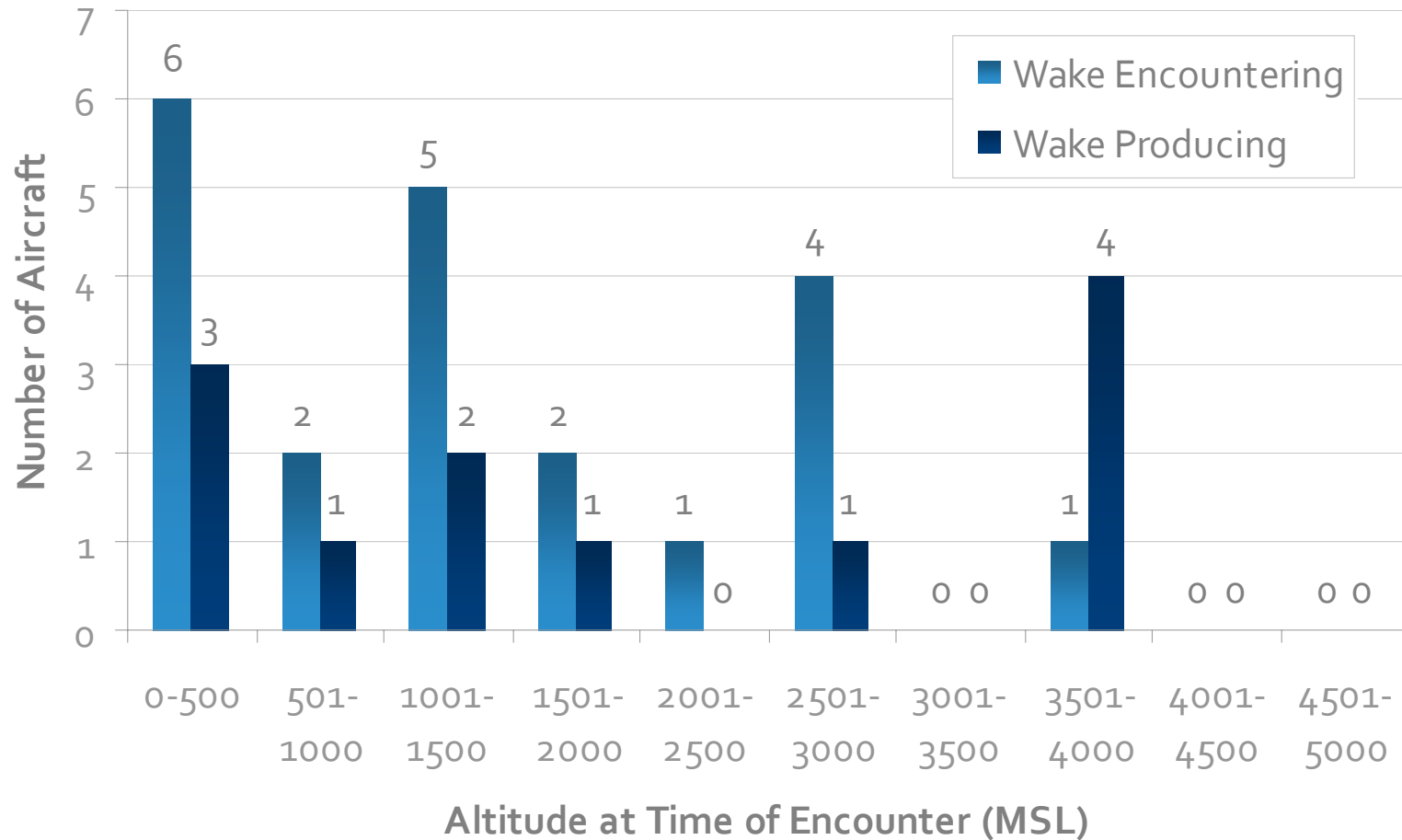
Oct 1, 2010



Altitude of Wake Encountering and Wake Producing Aircraft - Departure



Altitude of Wake Encountering and Wake Producing Aircraft (0-5000 MSL)- Departure



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Encounters in Terminal Airspace - Departure

n=28

		Wake Encountering Aircraft Weight Category					Total for Generating Category
		Heavy (H)	757	Large (L)	Small (S)	Unknown (U)	
Wake Producing Aircraft Weight Category	H			3			3
	757	1		3	1		5
	L			13	3		16
	S				1		1
	U			3			3
Total for Encountering Category		1		22	5		28



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Enroute Operations

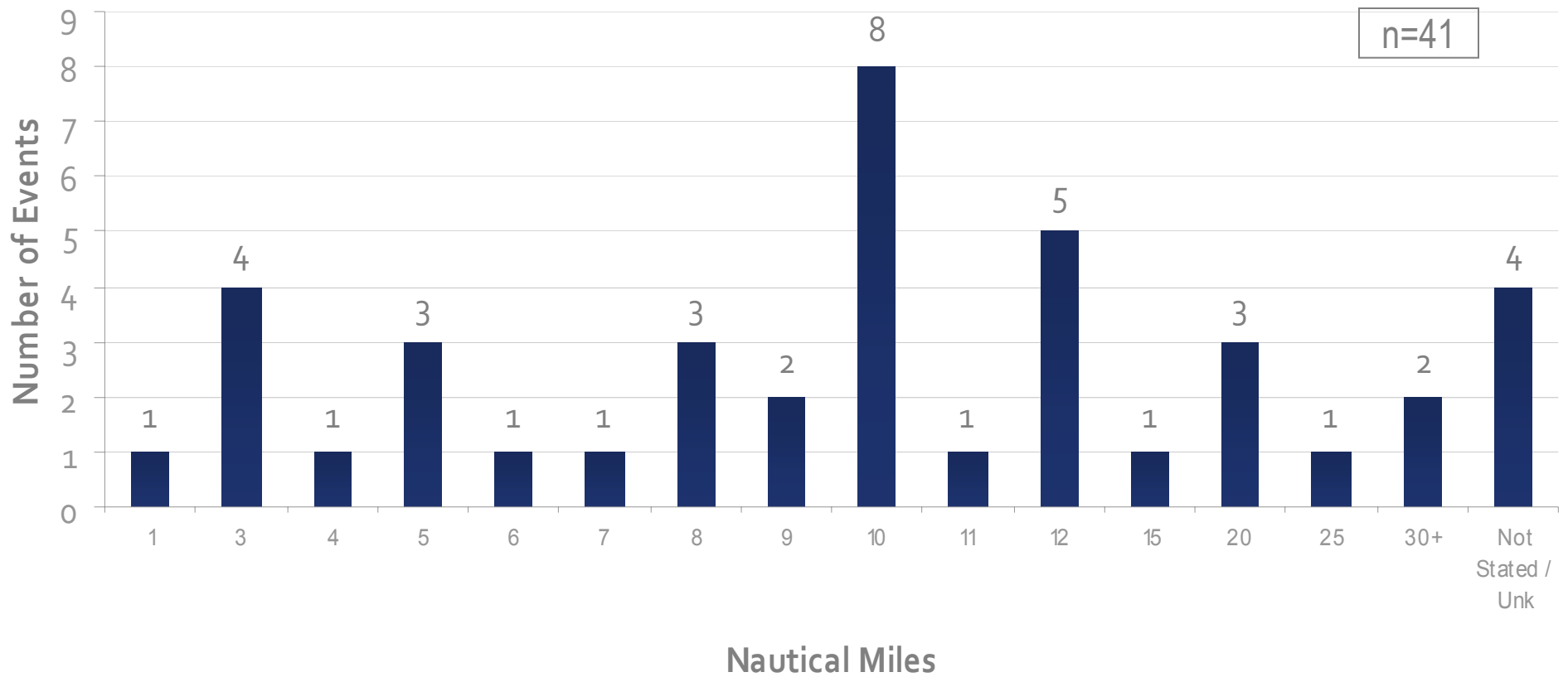
(n=41)



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Distance from Wake Producing Aircraft - Enroute



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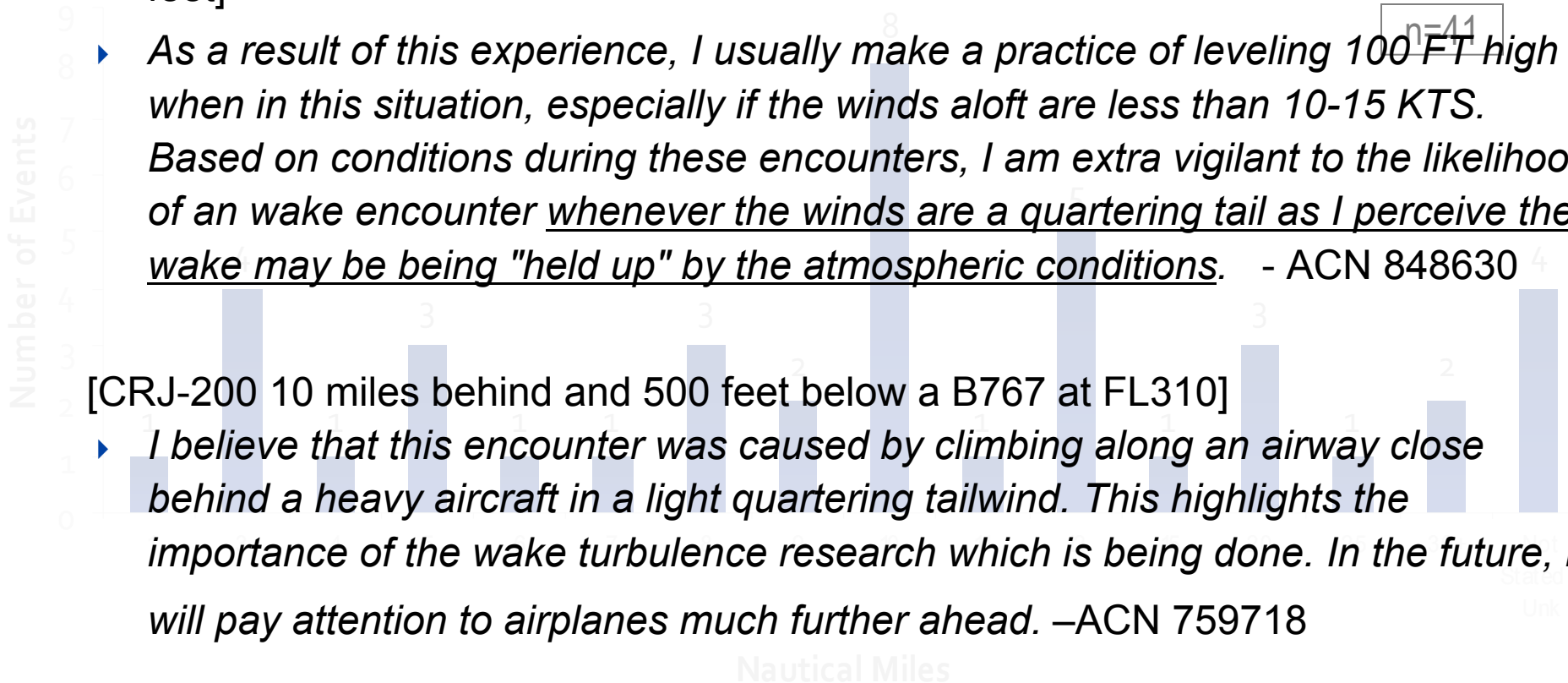
Distance from Wake Producing Aircraft - Enroute

[Global Express 15 miles behind an A320 encountered wake at FL240 and 16,000 feet]

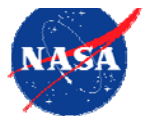
- ▶ *As a result of this experience, I usually make a practice of leveling 100 FT high when in this situation, especially if the winds aloft are less than 10-15 KTS. Based on conditions during these encounters, I am extra vigilant to the likelihood of an wake encounter whenever the winds are a quartering tail as I perceive the wake may be being "held up" by the atmospheric conditions. - ACN 848630*

[CRJ-200 10 miles behind and 500 feet below a B767 at FL310]

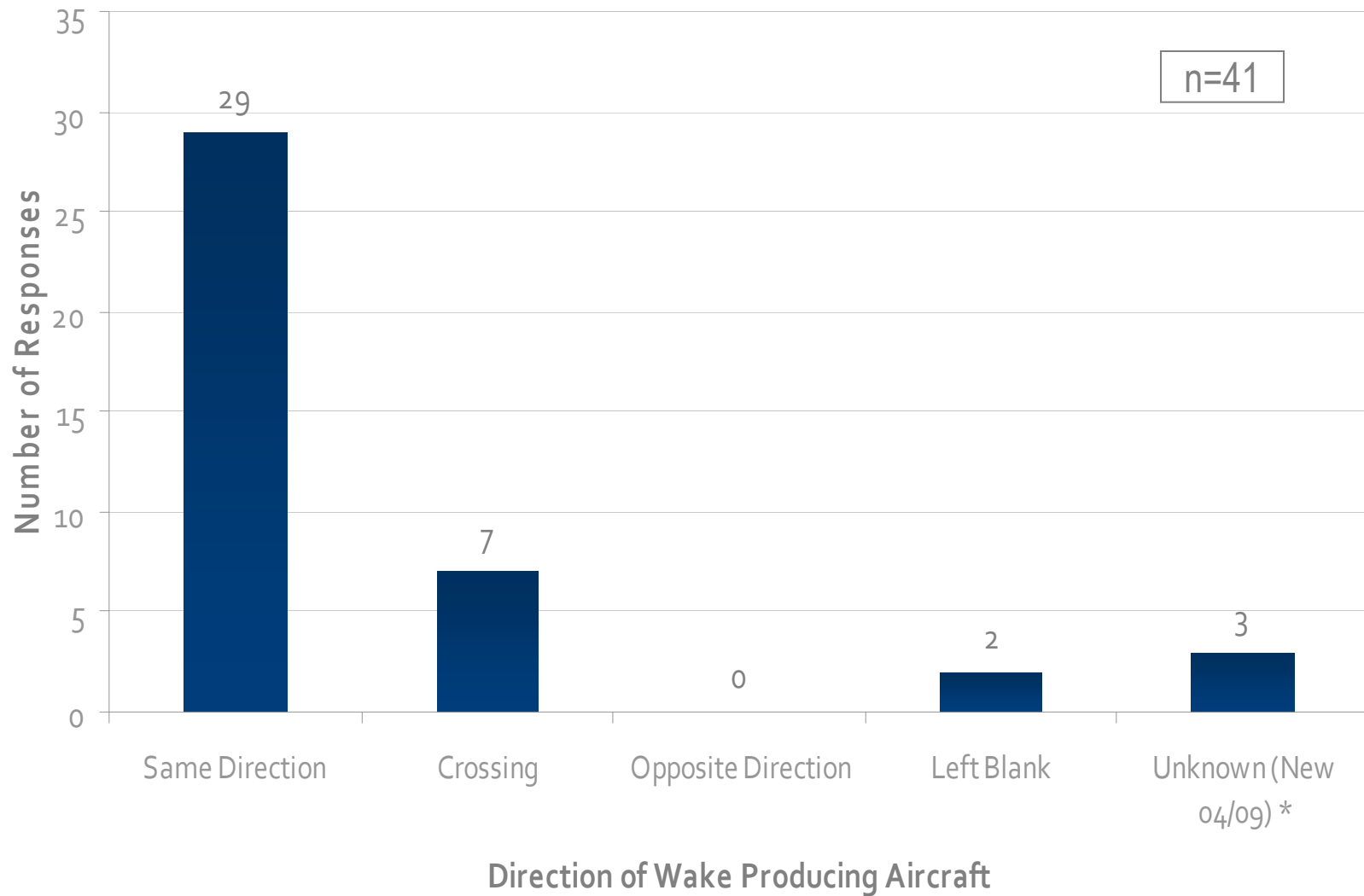
- ▶ *I believe that this encounter was caused by climbing along an airway close behind a heavy aircraft in a light quartering tailwind. This highlights the importance of the wake turbulence research which is being done. In the future, I will pay attention to airplanes much further ahead. -ACN 759718*



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Direction of Wake Producing Aircraft - Enroute

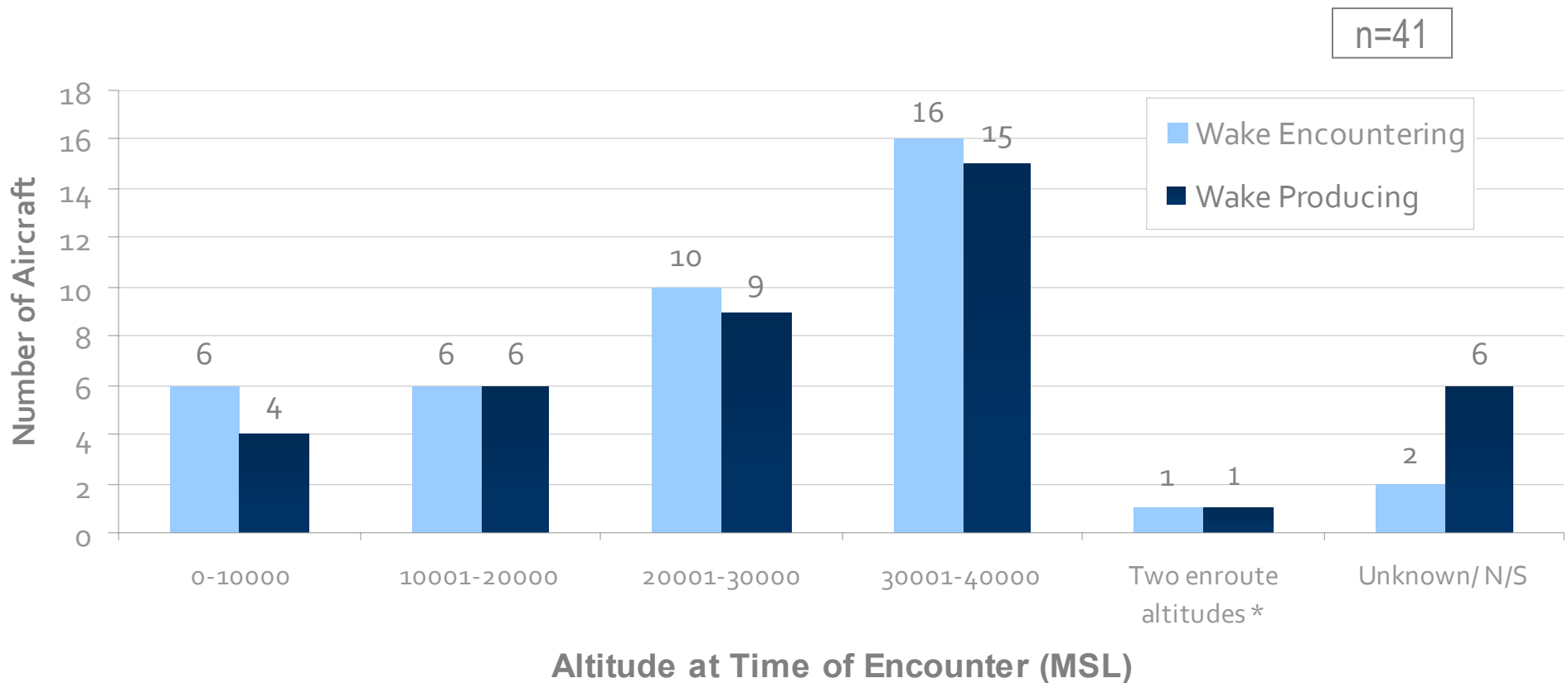


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• *Unknown was added as a new selection choice in the April 2009 revision to the SQS



Altitude of Wake Encountering and Wake Producing Aircraft - Enroute



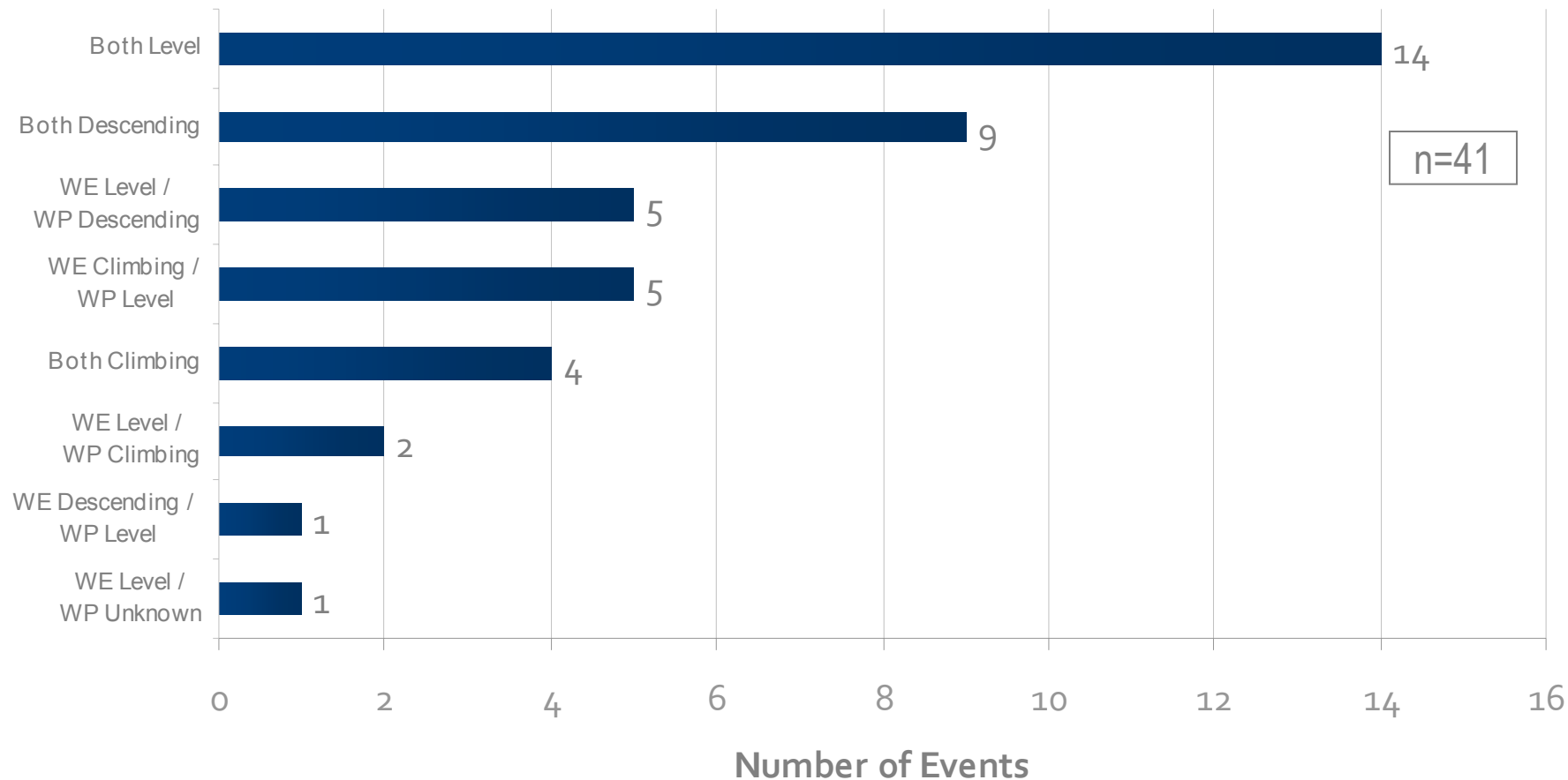
*1 aircraft encountered wake at 2 altitudes-- 10,500 MSL and 25,500 feet MSL (aircraft producing wake was 4,000 feet higher for each encounter)



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Flight Phase of Wake Producing and Wake Encountering Aircraft - Enroute



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Encounters in En Route Airspace - Enroute

n = 41

		Wake Encountering Aircraft Weight Category					
		Heavy (H)	757	Large (L)	Small (S)	Unknown (U)	Total for Generating Category
Wake Producing Aircraft Weight Category	H	2	1	10			13
	757			3	2		5
	L		2	5	5		12
	S	1			1		2
	U	4	1	4			9
Total for Encountering Category		7	4	22	8		41



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Effects and Consequences of Wake Encounters

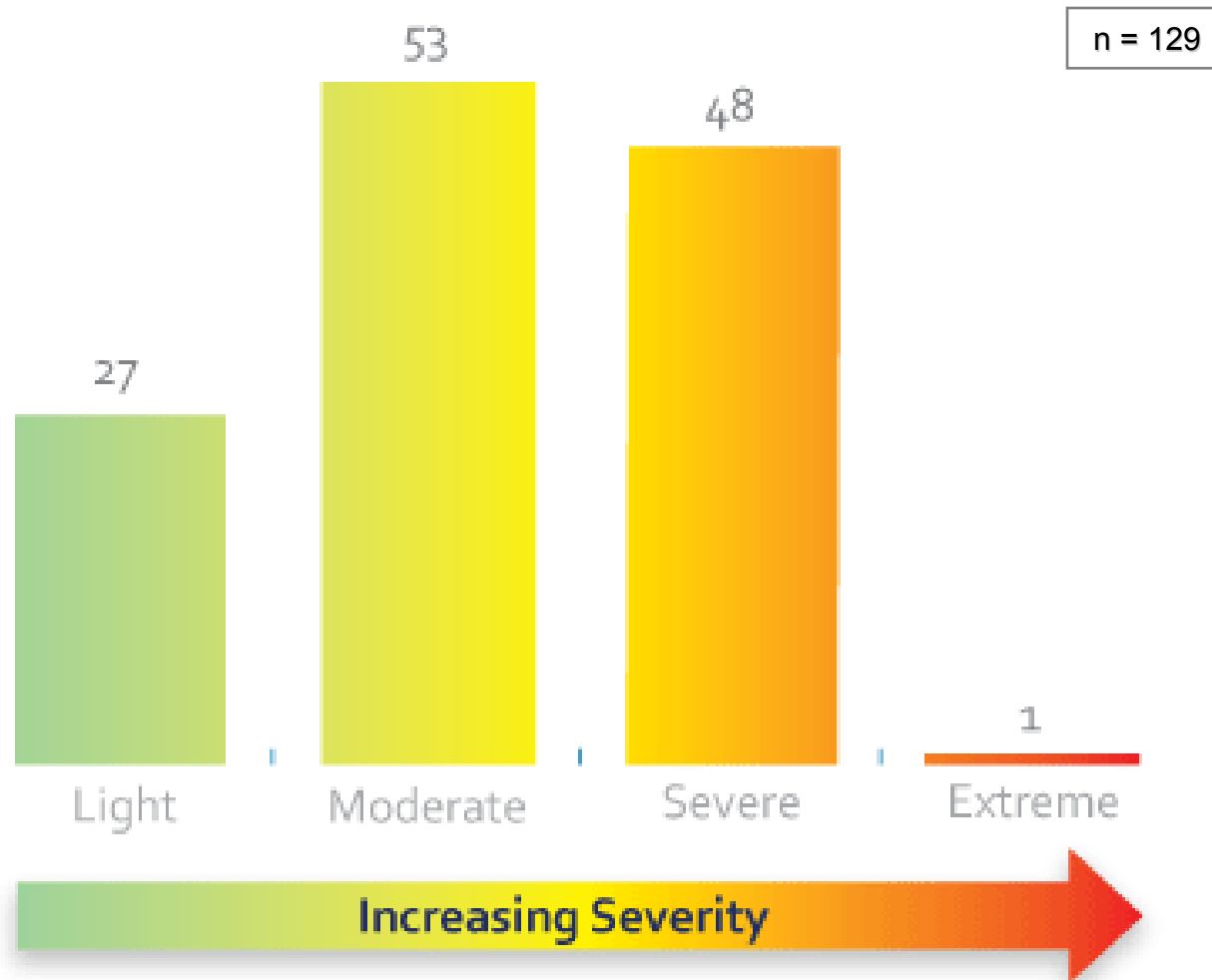
(n=129)



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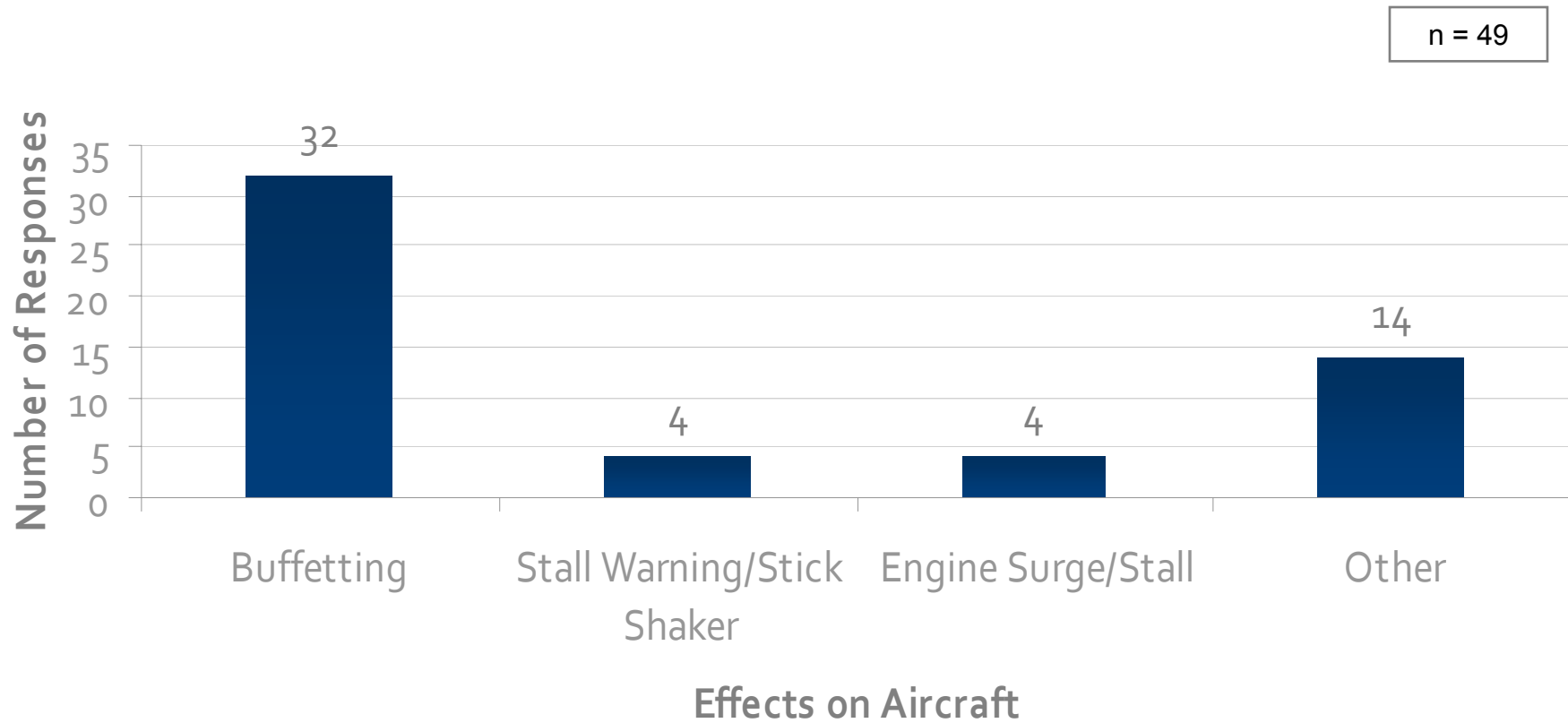
Pilot Assessment of the Magnitude of Wake Encounter



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Effects on Aircraft



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Effects on Aircraft categories are not mutually exclusive. A single event may be coded as having more than 1 consequence. 80 pilots did not report an effect on the aircraft.



Heading, Pitch, Roll and Yaw Changes

- ▶ **1 event categorized as EXTREME**
- ▶ **49 events categorized as SEVERE**
 - **Single event maximums**
 - Maximum reported heading change of 80°
 - Maximum reported pitch change of 45-50°
 - Maximum reported roll change of 110°
 - Maximum reported yaw change of 30°
- ▶ **53 events categorized as MODERATE**
- ▶ **27 events categorized as LIGHT**
- ▶ **Max reported altitude loss was 1200 ft**
- ▶ **Max reported altitude gain was 500 ft**

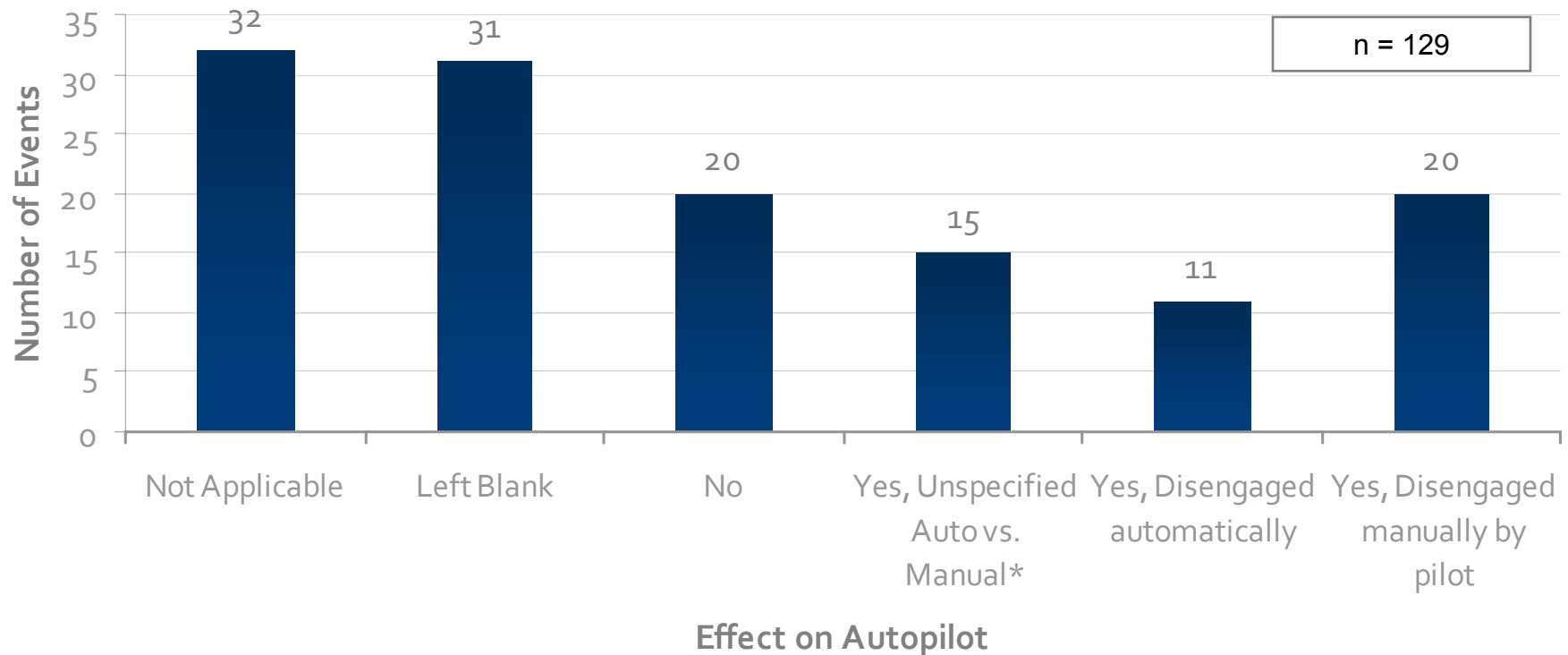


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Effect on Autopilot



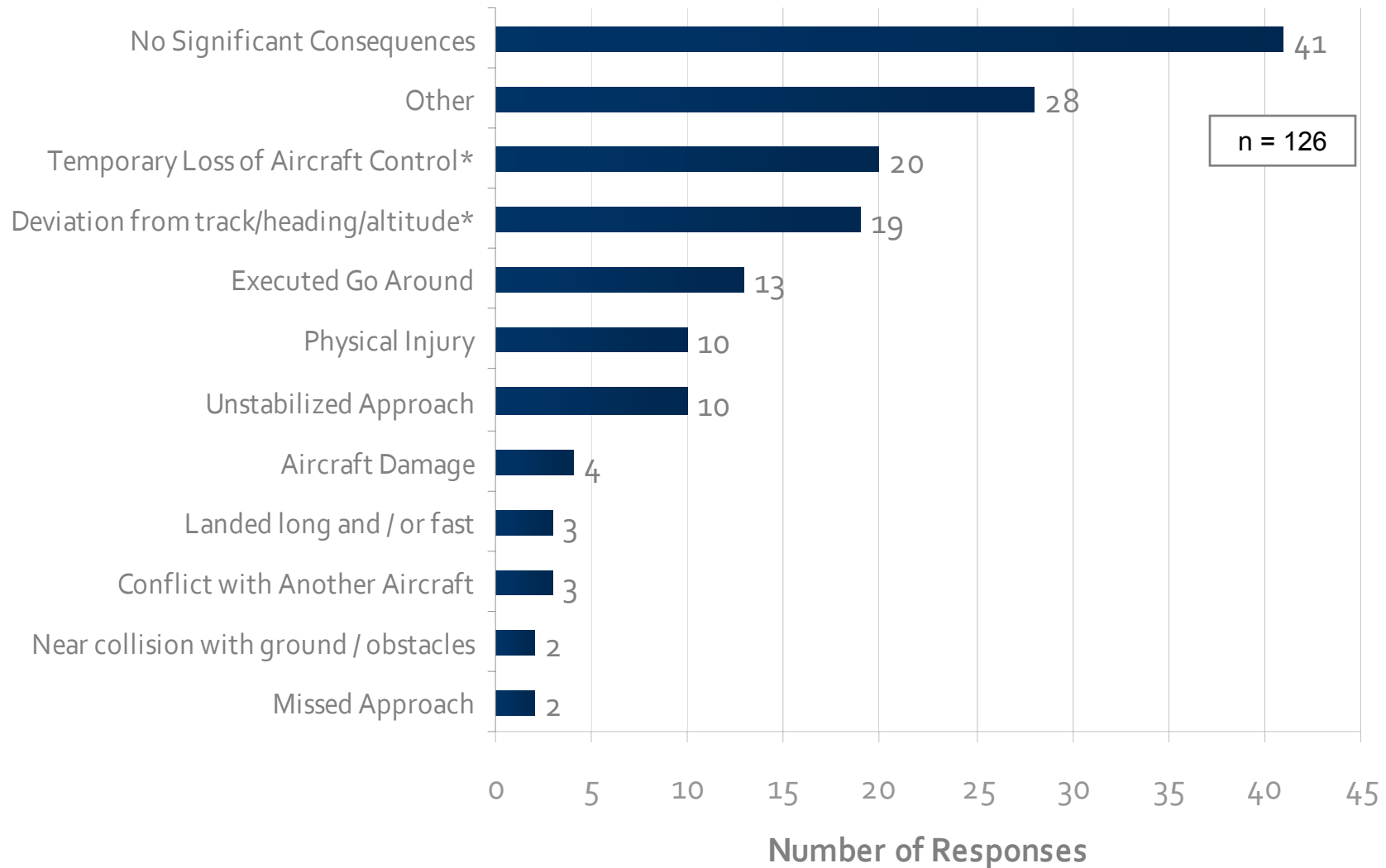
*Prior to April 2009 question update that distinguished between pilot disengaging or aircraft automatically disengaging. In April 2009, Question C.8 was revised to clarify automatic vs manual disengagement. It reads: C.8 If autopilot was engaged, did the wake encounter cause it to disengage? O Yes, disengaged automatically; O Yes, disengaged manually by pilot ; O No; O Not Applicable



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Consequences of WVE



- Consequence categories are displayed in the order they are presented in the Supplemental Question Set (SQS)
- n=126. Consequence categories are not mutually exclusive. A single event may be coded as having more than 1 consequence
- *“Temporary” was added in April 2009 based on pilot feedback



Notable Reporter Comments

(An A320 7 miles behind a B747-400 at 2500 feet MSL on arrival to LAX)

Report Narrative: ... We were following a B747 on a visual approach by 4.5 miles. We encountered wake turbulence at about the time we usually put the gear down. We encountered it again at 1000 feet one dot above the glide slope and I remembered being annoyed that the B747 was high on glide slope. We missed the 1000 foot call. At 700 feet the gear warning bell sounded and we put the gear down before 500 feet... Fortunately, the system worked and we landed safely. –ACN 899943



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Notable Reporter Comments

(A 737-800 10+ miles behind a B767-300 at 2500 feet on arrival to LAX)

Report Narrative: ...We were initially cleared for the ILS 25L approach ... to follow a B767 7 miles in front of us. ATC provided us the requisite caution wake turbulence following the heavy alert information. .. Shortly after the automated '2500 FT' audio call we experienced our first wake turbulence related roll. The pilot flying was already flying ½ dot to one dot high on the glideslope to risk mitigate the wake turbulence. Winds were calm at altitude and remained below 5 KTS and aligned with the runway throughout the approach and landing...

Shortly after passing LIMMA we experienced our second, much more pronounced and persistent roll associated with the heavy's wake turbulence....I failed to respond to [my] normal habit pattern because of my focus on the B767 in front of us and our flight path in relation to the heavy's. Consequently we landed without acknowledging ATC's 'cleared to land' call and I didn't realize it until we rolled out onto the high speed taxiway...That series of decisions drew my focus to the remainder of the approach and I believe was the critical event which distracted me to the point my clearance to land mnemonic wasn't accomplished and consequently the ATC clearance not acknowledged. ACN-897473



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