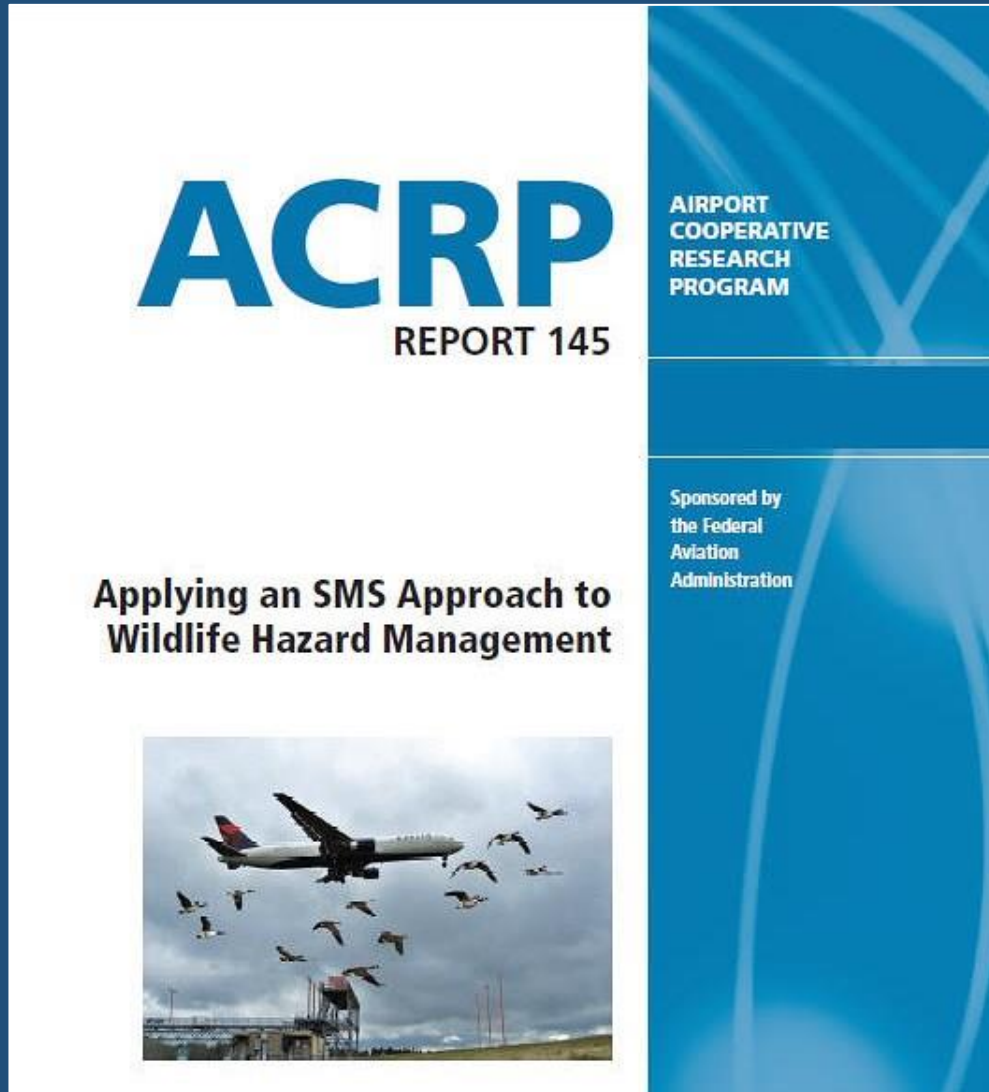# Integrating Wildlife Hazard Management into Airport Safety Management Systems

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Project Objectives

- Address integration of wildlife management programs into airport Safety Management Systems (SMS)
- Develop a quantitative wildlife risk tool that includes:
  - Wildlife hazard
  - Airport operations by airport and aircraft class
  - Habitat on and off airport by varying distances
  - Current wildlife control practices on and off airport
  - Future wildlife control practices on and off airport

SMS and Wildlife Management Programs

- "Perfect fit"
- Continuous data collection, monitoring, feedback, and improvement

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Safety Management System (SMS)

SMS Components

Safety Assessment (SA)
The risk assessment comprised
of a panel of Subject Matter Experts.

Safety Risk Management (SRM)
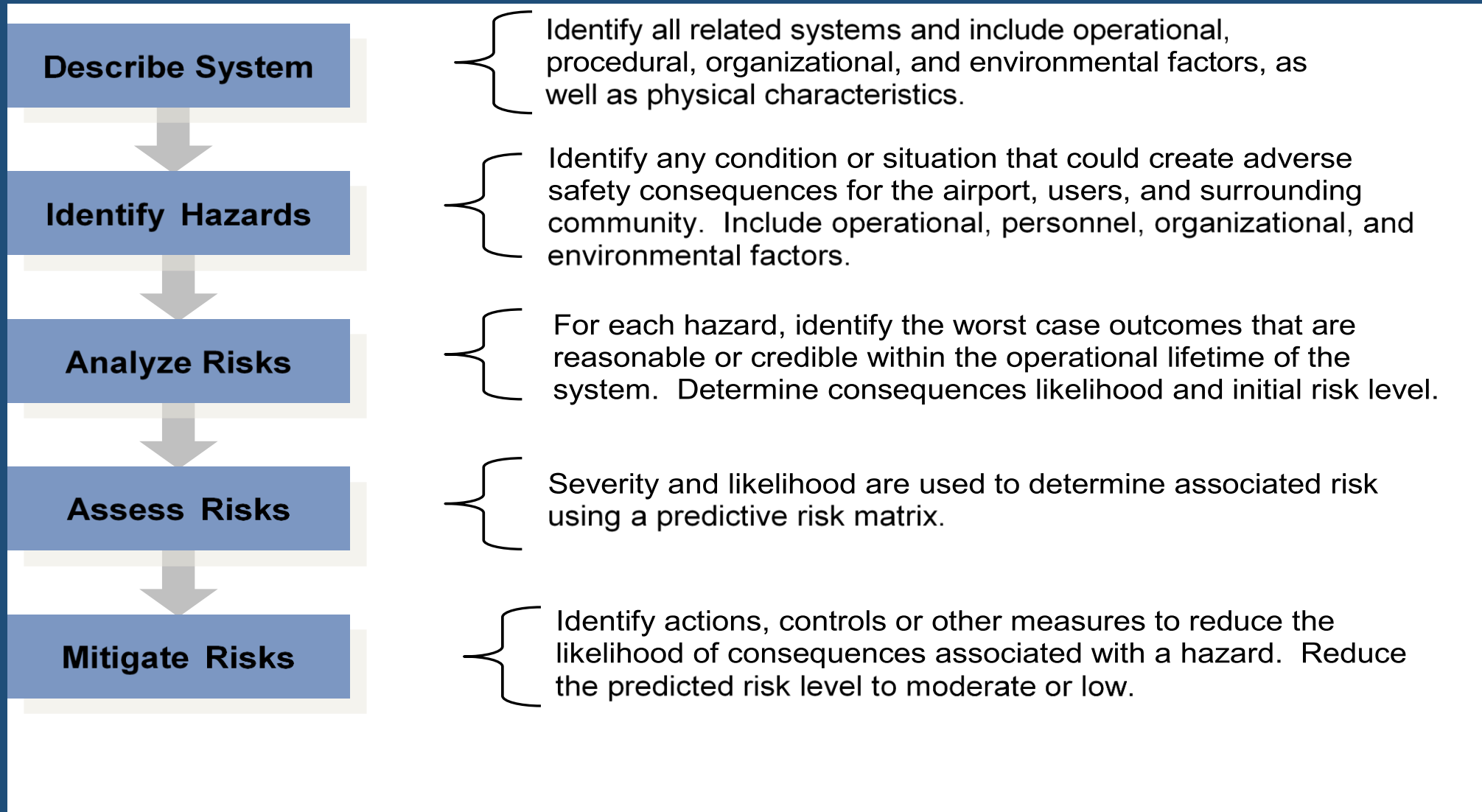The process / program of identifying hazards,
analyzing and assessing the risks, mitigating the
risks, monitoring, and feedback for improvement.

Safety Management System (SMS)
The overall system of processes, procedures,
policies, etc.

SMS Risk Mitigation

Describe System

Identify all related systems and include operational, procedural, organizational, and environmental factors, as well as physical characteristics.

Identify Hazards

Identify any condition or situation that could create adverse safety consequences for the airport, users, and surrounding community. Include operational, personnel, organizational, and environmental factors.

Analyze Risks

For each hazard, identify the worst case outcomes that are reasonable or credible within the operational lifetime of the system. Determine consequences likelihood and initial risk level.

Assess Risks

Severity and likelihood are used to determine associated risk using a predictive risk matrix.

Mitigate Risks

Identify actions, controls or other measures to reduce the likelihood of consequences associated with a hazard. Reduce the predicted risk level to moderate or low.

Hazard vs. Risk

- Terms often confused—sometimes used interchangeably or defined via a combination of variables

  Hazard—a condition in the environment that is a potential source of "harm"
  - Magnitude of a hazard is often referred to as "severity" in safety literature/SMS

  Risk—probability of harm if exposed to a hazard
  - Probability of exposure is often referred to as "likelihood" in safety literature/SMS
  - Actual "RISK" is a combination of hazard/severity and exposure/likelihood

WHaMRAT

- **WHaMRAT—Wildlife Hazard Management Risk Assessment Tool**
  - Just one of the tools in the SMS toolbox
- **EZ vs. Advanced Versions**
  - Discrimination within wildlife guilds defines difference
  - Guild-level discrimination in EZ Version
  - Species-level discrimination within guilds in Advanced Version

SMS Process and WHaMRAT Integration

Safety Risk Management Process and WHaMRAT Tool Use and Integration
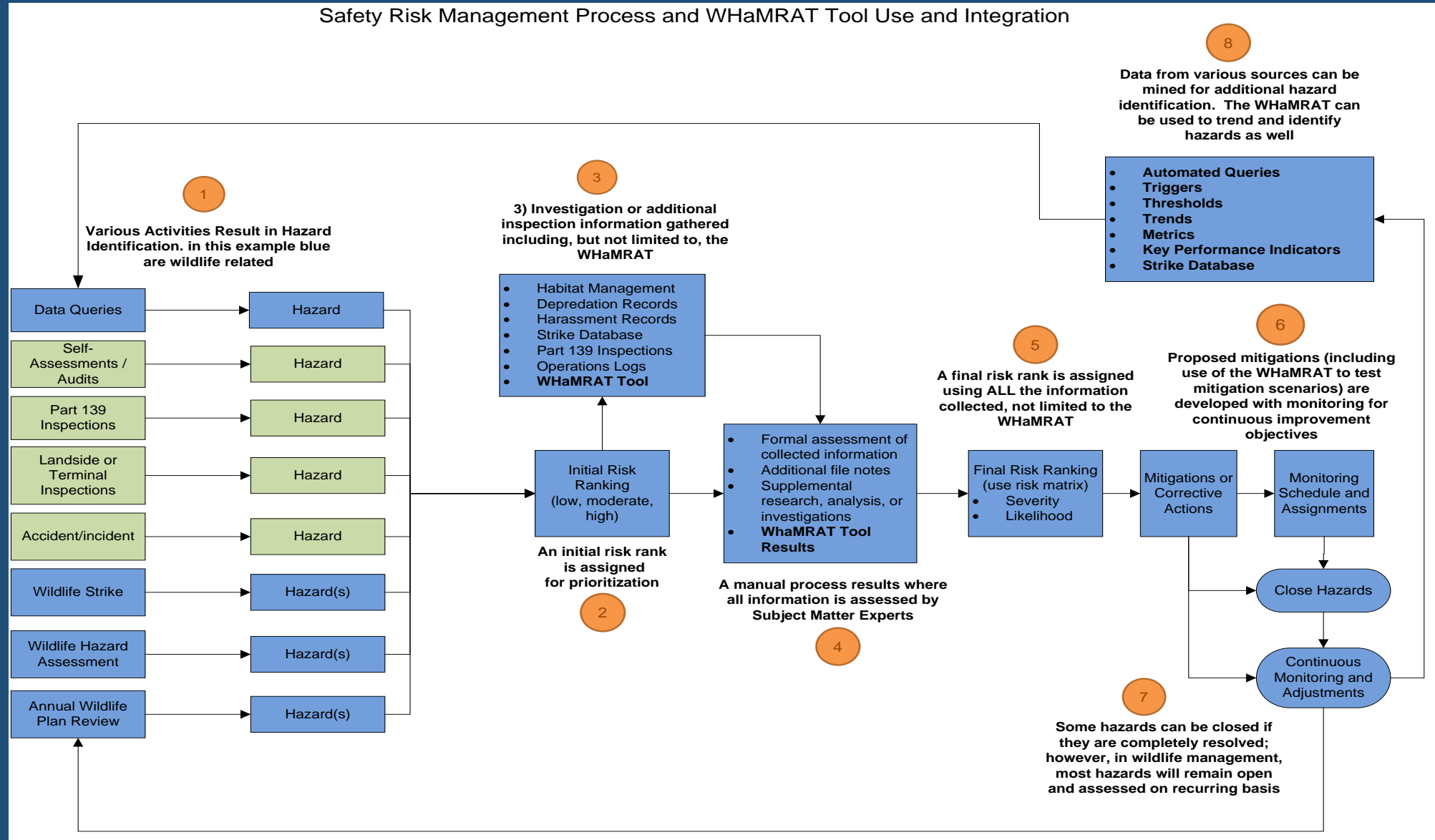
WHaMRAT Process
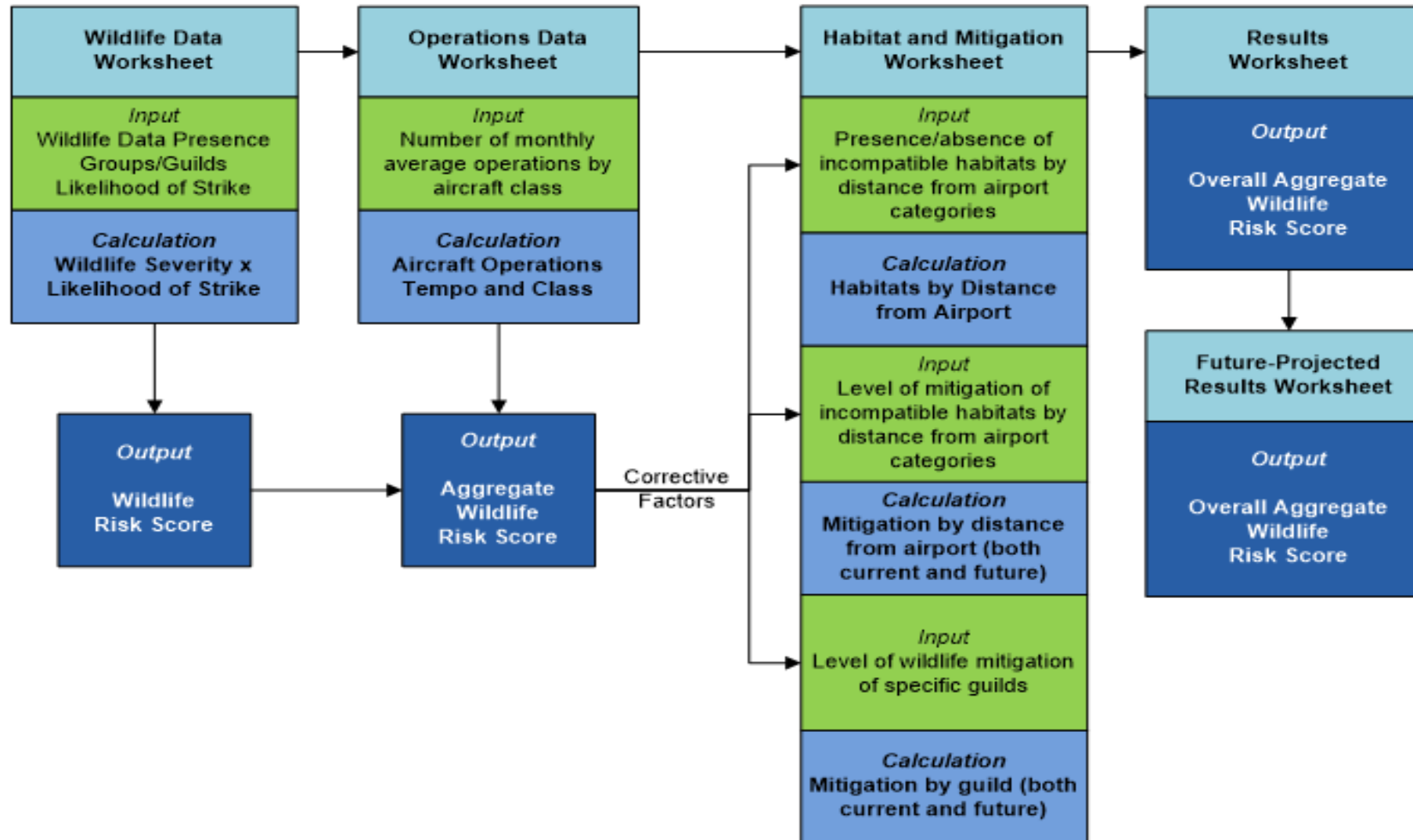
Wildlife Hazard Risk Matrix—Likelihood vs. Severity
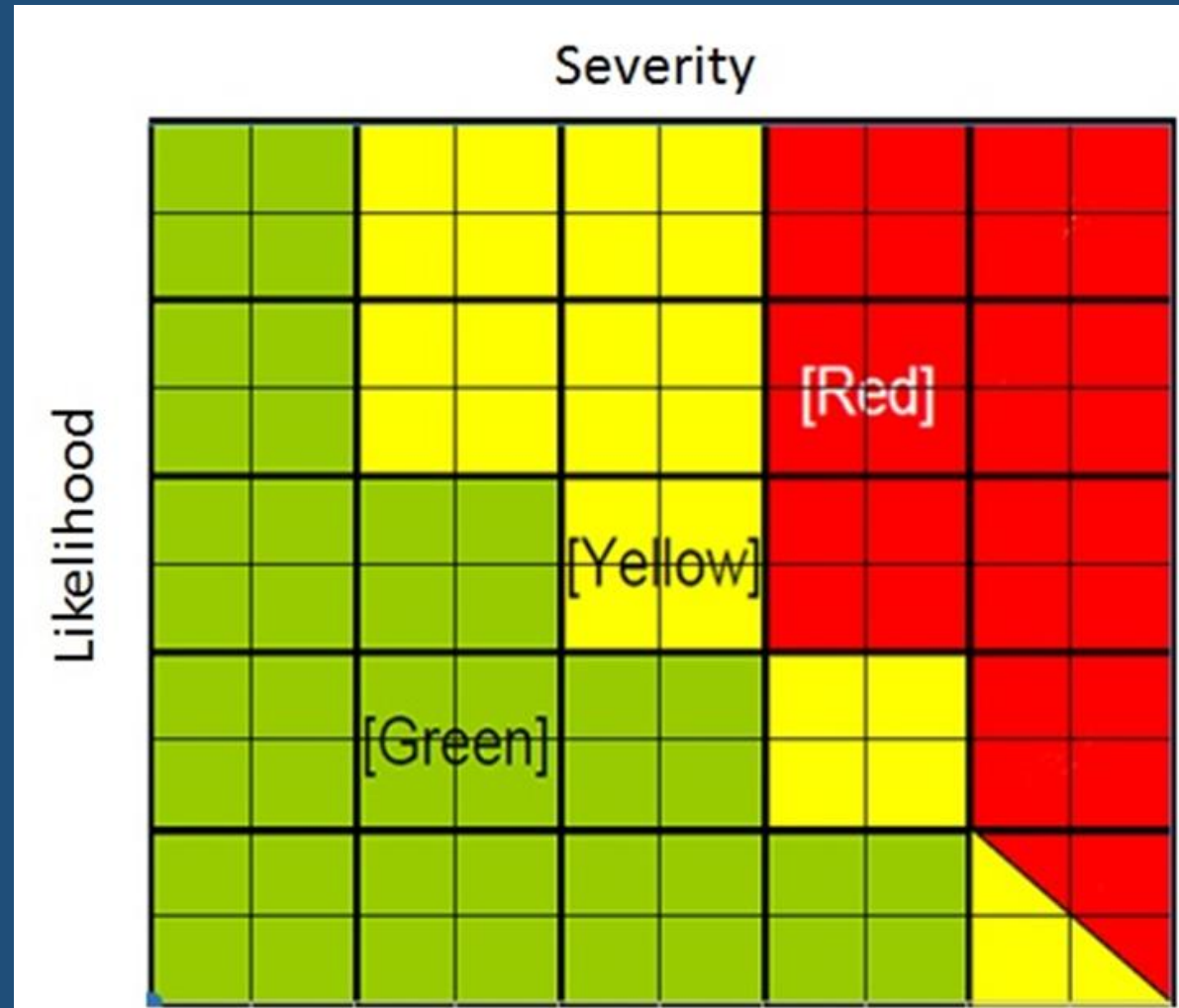
FAA Order 8040.4A

Avian Guilds

1. Waterbirds
2. Seabirds
3. Pelicans/Cormorants
4. Waders
5. Waterfowl
6. Raptors/Vultures/Owls
7. Upland Game Birds
8. Cranes
9. Shorebirds

10. Gulls/Terns
11. Pigeons/Doves
12. Parrots
13. Aerial Foragers
14. Woodland Birds
15. Corvids
16. Grassland Birds
17. Blackbirds/Starlings
18. Miscellaneous

Avian Guild Severity—EZ WHaMRAT

Guilds	Severity
Waterbirds	2
Seabirds	2
Pelicans/Cormorants	4
Waders	2
If flocks ≥ 5	5
Waterfowl	3
If flocks < 5	4
If flocks ≥ 5	5
Raptors/Vultures/Owls	2
Upland Game Birds	2
If Turkeys	5
Cranes	5
Shorebirds	1
If flocks < 15	4
If flocks ≥ 15	5
Gulls/Terns	2
If flocks < 10	4
If flocks ≥ 10	5
Pigeons/Doves	1
If flocks < 20	4
If flocks ≥ 20	5
Parrots	1
Aerial Foragers	1
Woodland Birds	1
Corvids	2
If flocks < 10	4
If flocks ≥ 10	5
Grassland Birds	1
Blackbirds/Starlings	1
If flocks < 100	4
If flocks ≥ 100	5
Miscellaneous	1
Criteria for Score	Severity
Less than 300g	1
300-999g	2
1000-1999g	3
2000-3999g	4
Greater than 4000g	5

Hazard level is based strictly on body mass

Body mass varies significantly within guilds

Each guild has a singular severity value based on average body mass within guild. Increased severity levels to account for flocking behavior

Non-Avian Guilds
Mammals

1) **Rodents** – Beavers, Squirrels, Rats, Mice, Ground Squirrels, Shrews, Prairie Dogs, Marmots, Chipmunks, Pocket Gophers, Voles, Lemmings

2) **Lagomorphs** – Rabbits, Hares, Pikas

3) **Bats** – Bats

4) **Mesomammals** – Opossums, Armadillos, Weasels, Minks, Martins, Wolverines, Badgers, Otters, Skunks, Raccoons

5) **Canids** – Coyotes, Wolves, Foxes, Domestic Dogs

6) **Felids** – Bobcats, Lynxes, Mountain Lions, Feral Cats

7) **Hooved** – Horses, Hogs/Pigs, Deer, Elk, Moose, Caribou, Antelope, Sheep

8) **Bears** – Bears

Non-Avian Guilds
Reptiles and Amphibians

1) **Alligators/Crocodiles** – Alligators, Crocodiles

2) **Turtles** – Turtles, Tortoises

3) **Iguanas** – Iguanas

4) **Lizards/Snakes** – Smaller Lizards and Most Snakes

Non-Avian Guild Severity—EZ WHaMRAT

Guilds	Severity
Rodents	2
Lagomorphs	4
Bats	1
Mesomammals	4
Canids	5
Felids	5
Hooved	5
Bears	5
Turtles	2
Iguanas	2
Lizards/Snakes	2
Crocodiles/Alligators	5
Criteria for Score	Severity
0-99g	1
100-599g	2
600-1999g	3
2000-9999g	4
Greater than 10000g	5

Hazard is based strictly on body mass

Body mass varies significantly within guilds

Each guild has a singular severity value with increasing value as average body mass (within guild) increases.

Likelihood Scoring

(Value based on relative abundance of wildlife observations for a particular guild)

1) **Species not present at all**: likelihood score of "0" or cell left blank.

2) **Rare**: likelihood score of "1".

3) **Uncommon**: likelihood score of "2".

4) **Fairly Common**: likelihood score of "3".

5) **Common**: likelihood score of "4".

6) **Abundant**: likelihood score of "5".
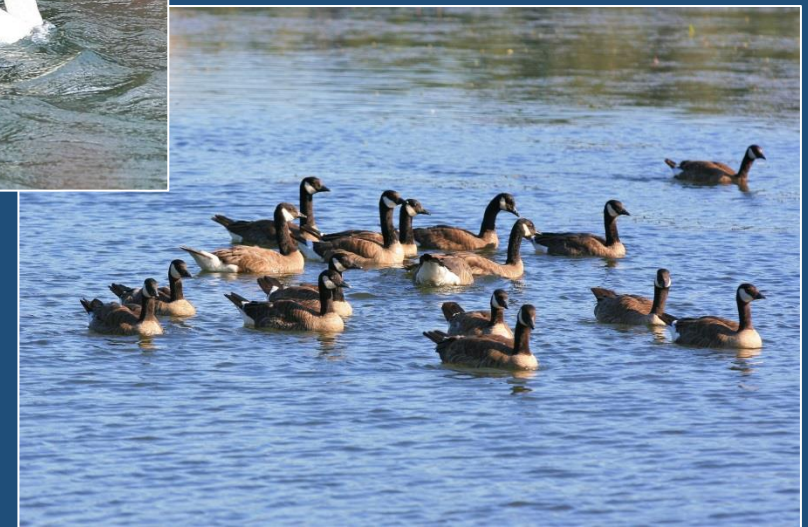
Wildlife Risk Value

Function of Wildlife Severity and Likelihood of Strike by Guild

Results in a "cloud" of points that the model resolves into a singular objective risk value

Wildlife Severity vs Likelihood of Strike
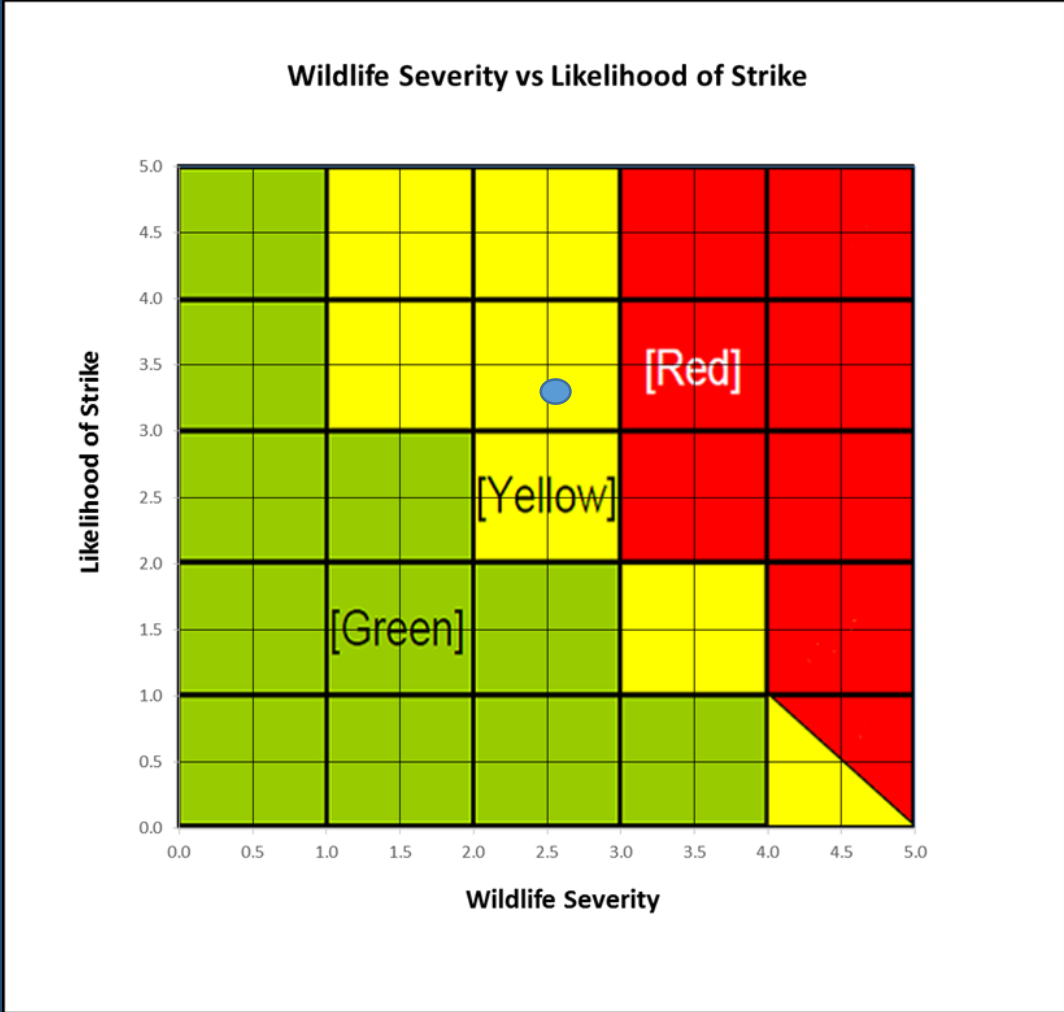
Operations Risk Value

- Aircraft Type
  - Susceptibility to damage varies

- Operations Tempo
  - Segregated by movements of each aircraft type

- Aircraft susceptibility to wildlife strike damage by category derived from FAA Wildlife Strike Database

NPIAS Aircraft Designations

1) Commercial
2) Air Taxi
3) General Aviation
4) Military
5) Rotary

Effect of Aircraft Operations

(Operations risk value increases non-linearly as operations increase and plateaus as operations reach high values)

Shape of the Operations Adjustment Curve

Y-axis: Aggregate Operations Risk Number (from -1 to 1.2)

X-axis: Number of Monthly Average Aircraft Movements Adjusted for US Average Monthly Aircraft Movements
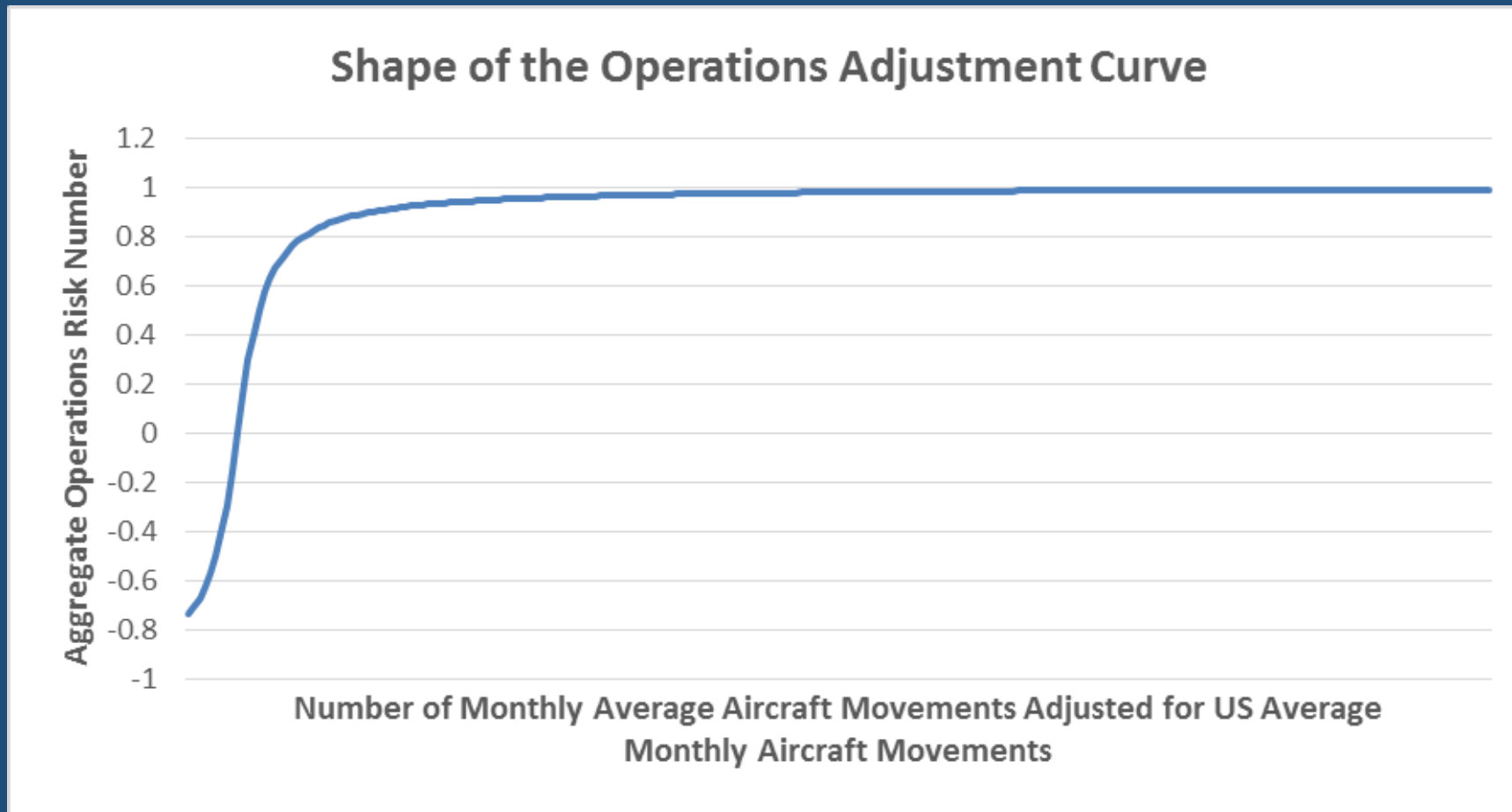
Aggregate Wildlife Risk

Function of Wildlife Risk and Operations Risk

Results in a "cloud" of points by aircraft class that the model resolves into a singular objective risk value

Overall Aggregate Wildlife Risk
Wildlife Risk vs Operations Risk
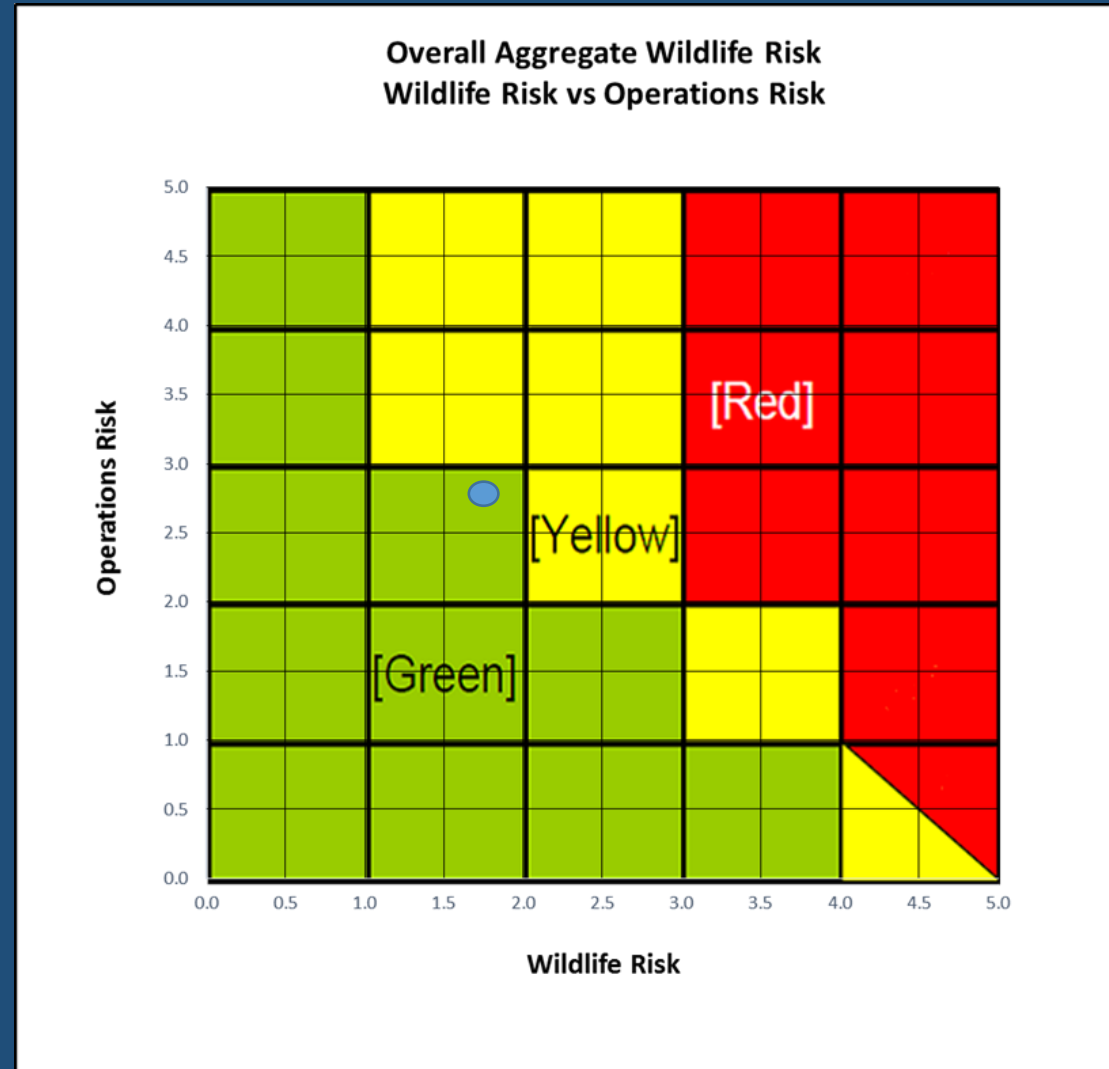
Habitat On and Off Airport

- **Specific incompatible habitats within WHaMRAT include:**
1) Solid waste open landfill.
2) Enclosed trash transfer.
3) Composting operations.
4) Underwater waste discharge.
5) Stormwater collection.
6) Wastewater treatment facility.
7) Artificial marsh.
8) Natural wetlands.

9) Agricultural crops.
10) Livestock production.
11) Aquaculture.
12) Golf courses.
13) Woodlands/forests.
14) Landscaping.
15) Synergistic effects of authorized uses.
16) User-defined #1.
17) User-defined #2.
18) User-defined #3.

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Habitat Location Criteria

1) Airport property within perimeter fence.

2) Outside perimeter fence within 10,000-foot or 5,000-foot separation distances.

3) Greater than 10,000-foot or 5,000-foot separation, within 5-miles, and in the traffic pattern.

4) Greater than 10,000-foot or 5,000-foot separation, within 5-miles, and not in the traffic pattern.

5) Greater than 5-miles but wildlife movement potential across airport.

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Effect of Habitat by Distance

Distance	Points
Airport Property Within Perimeter Fence	10
Outside Perimeter Fence within 10,000-foot or 5,000-foot separation	7
> 10,000 or 5,000-foot separation, within 5-miles, and in traffic pattern	4
>10,000 or 5,000-foot separation, within 5-miles, not in traffic patterns	2
> 5-miles but wildlife movement potential across airport	1

Closer proximity to airport AOA yields greatest value

Wildlife Management and Control Hierarchy

EZ WHaMRAT—Wildlife Risk

EZ WHaMRAT—Aircraft Operations Risk

EZ WHaMRAT—Habitat and Mitigation Factors

Overall Aggregate Wildlife Risk Score
(Resultant value based on wildlife risk, operations risk, and habitat-mitigation adjustments)

EZ WHaMRAT—Results

EZ WHaMRAT—Future-Projected Results
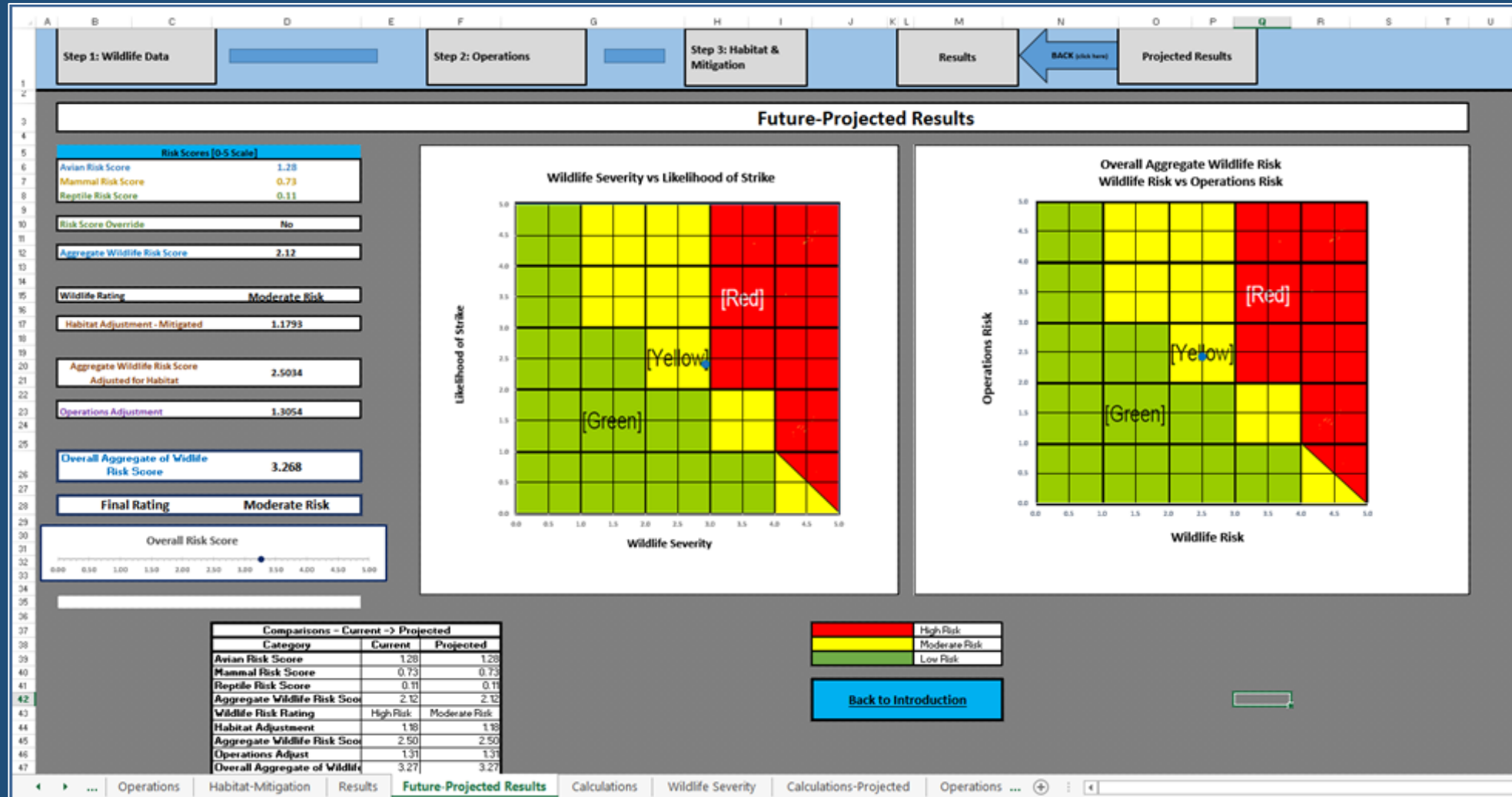
Advanced WHaMRAT

- **Differs from EZ WHaMRAT by allowing wildlife severity to be determined by specific species within guilds and their associated differences in body mass**

Avian Guild Severity—Advanced WHaMRAT

Guild	Severity
Waterbirds	
Waterbirds < 300g	1
Waterbirds 300-999g	2
Waterbirds 1000-1999g	3
Waterbirds 2000-3999g	4
Waterbirds > 4000g	5
Seabirds	
Seabirds < 300g	1
Seabirds 300-999g	2
Seabirds 1000-1999g	3
Seabirds 2000-3999g	4
Pelicans/Cormorants	
Pelicans 1000-1999g	3
Pelicans 2000-3999g	4
Pelicans > 4000g	5
Waders	
If flocks ≥ 5	5
Waders < 300g	1
Waders 300-999g	2
Waders 1000-1999g	3
Waders 2000-3999g	4
Waterfowl	
If flocks < 5	4
If flocks ≥ 5	5
Waterfowl 300-999g	2
Waterfowl 1000-1999g	3
Waterfowl 2000-3999g	4
Waterfowl > 4000g	5
Raptors/Vultures/Owls	
Raptors < 300g	1
Raptors 300-999g	2
Raptors 1000-1999g	3
Raptors 2000-3999g	4
Raptors > 4000g	5

Guilds subdivided into body mass classes with associated increase in hazard/severity as body mass increases

Avian Species by Guild with Varied Body Mass

Gulls/Terns			
		If Flocks < 10	4
		If Flocks ≥ 10	5
Common Name	Scientific Name	Guild (Mass)	Severity
Forster's Tern	Sterna forsteri	Gulls/Terns <300g	1
Great Crested Tern	Thalasseus bergii	Gulls/Terns <300g	1
Sandwich Tern	Thalasseus sandvicensis	Gulls/Terns <300g	1
Elegant Tern	Thalasseus elegans	Gulls/Terns <300g	1
Black-headed Gull	Chroicocephalus ridibundus	Gulls/Terns 300-999g	2
Franklin's Gull	Leucophaeus pipixcan	Gulls/Terns 300-999g	2
Belcher's Gull	Larus belcheri	Gulls/Terns 300-999g	2
Black-tailed Gull	Larus crassirostris	Gulls/Terns 300-999g	2
Heermann's Gull	Larus heermanni	Gulls/Terns 300-999g	2
Mew Gull	Larus canus	Gulls/Terns 300-999g	2
Ring-billed Gull	Larus delawarensis	Gulls/Terns 300-999g	2
California Gull	Larus californicus	Gulls/Terns 300-999g	2
Iceland Gull	Larus glaucoides	Gulls/Terns 300-999g	2
Lesser Black-backed Gull	Larus fuscus	Gulls/Terns 300-999g	2
Caspian Tern	Hydroprogne caspia	Gulls/Terns 300-999g	2
Royal Tern	Thalasseus maximus	Gulls/Terns 300-999g	2
Black Skimmer	Rynchops niger	Gulls/Terns 300-999g	2
Western Gull	Larus occidentalis	Gulls/Terns 1000-1999g	3
Yellow-footed Gull	Larus livens	Gulls/Terns 1000-1999g	3
Herring Gull	Larus argentatus	Gulls/Terns 1000-1999g	3
Yellow-legged Gull	Larus michahellis	Gulls/Terns 1000-1999g	3
Thayer's Gull	Larus thayeri	Gulls/Terns 1000-1999g	3
Slaty-backed Gull	Larus schistisagus	Gulls/Terns 1000-1999g	3
Glaucous-winged Gull	Larus glaucescens	Gulls/Terns 1000-1999g	3
Glaucous Gull	Larus hyperboreus	Gulls/Terns 1000-1999g	3
Great Black-backed Gull	Larus marinus	Gulls/Terns 1000-1999g	3
Kelp Gull	Larus dominicanus	Gulls/Terns 1000-1999g	3

Non-Avian Guild Severity—Advanced WHaMRAT

Guild	Severity
Rodents	
Rodents < 100g	1
Rodents 100-599g	2
Rodents 600-1999g	3
Rodents 2000-9999g	4
Rodents > 10000g	5
Lagomorphs	
Lagomorphs 100-599g	2
Lagomorphs 2000-9999g	4
Bats	
Bats < 100g	1
Bats 100-599g	2
Mesomammals	
Mesomammals 100-599g	2
Mesomammals 600-1999g	3
Mesomammals 2000-9999g	4
Mesomammals > 10000g	5
Canids	
Canids 2000-9999g	4
Canids > 10000g	5
Felids	
Felids 600-1999g	3
Felids > 10000g	5
Hooved	
Hooved > 10000g	5
Bears	
Bears > 10000g	5
Turtles	2
Iguanas	2
Lizards/Snakes	2
Crocodiles/Alligators	5
Criteria for Score	Severity
0-99g	1
100-599g	2
600-1999g	3
2000-9999g	4

Guilds subdivided by body mass classes with associated increase in hazard/severity as body mass increases

Mammalian Species within a Guild with Varied Body Mass

Common Name	Scientific Name	Guild (Mass)	Severity
Domestic/Feral Dog	Canis familiaris	Canids 2000-9999g	4
Arctic fox	Alopex lagopus	Canids 2000-9999g	4
Swift fox	Vulpes velox	Canids 2000-9999g	4
Kit fox	Vulpes macrotis	Canids 2000-9999g	4
Red fox	Vulpes vulpes	Canids 2000-9999g	4
Gray fox	Urocyon cinereoargenteus	Canids 2000-9999g	4
Island gray fox	Urocyon littoralis	Canids 2000-9999g	4
Coyote	Canis latrans	Canids >10000g	5
Gray wolf	Canis lupus	Canids >10000g	5
Eastern timber wolf	Canis lycaon	Canids >10000g	5
Red Wolf	Canis rufus	Canids >10000g	5

Advanced WHaMRAT—Wildlife Risk

WHaMRAT Summary

- Results of the WHaMRAT models are objective scores used as baselines for airports to monitor continuous improvements within their SMS programs

- WHaMRAT is but one tool in the box to be used as part of airports' SMS programs
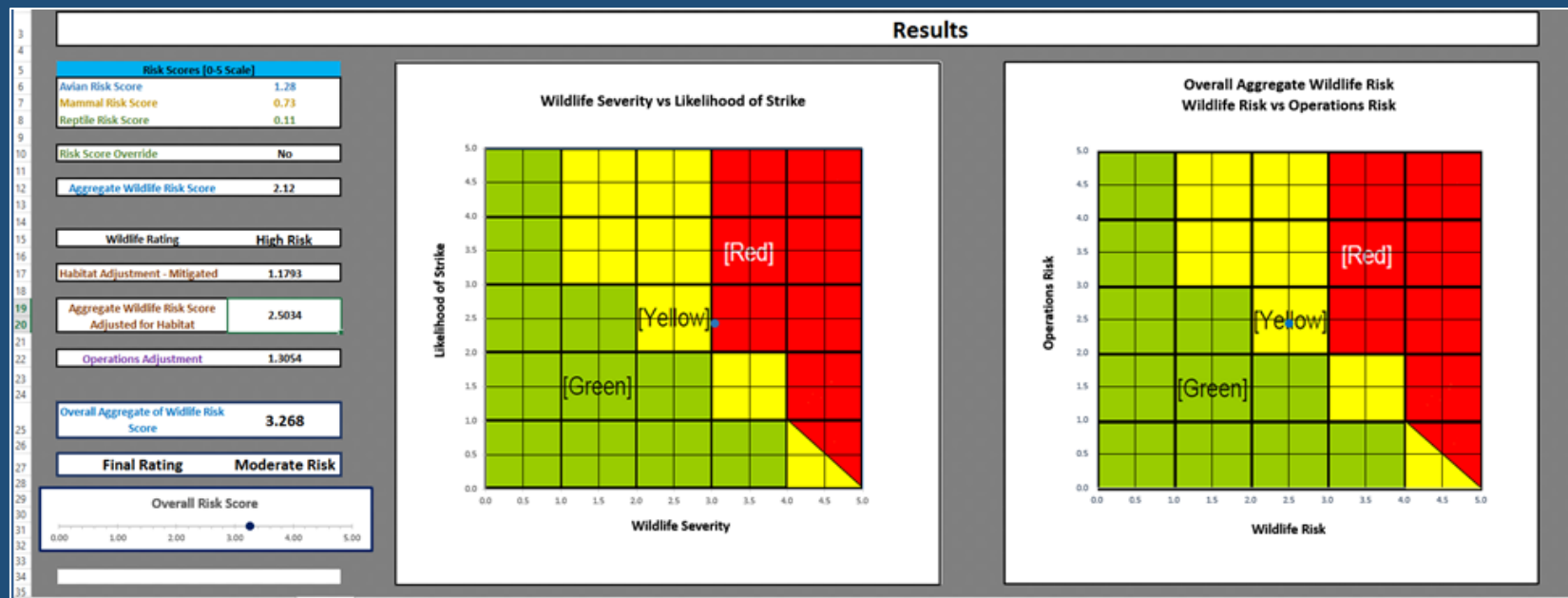
Conclusion

- Wildlife management programs are a "perfect fit" within airport SMS programs

- ICAO and FAA mandate SMS implementation

- ACRP 145 is "on the shelf" and awaiting your use!