ecoda Environmental Consulting

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Environmental Issues and Wind Energy Development in Egypt

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Structure of Presentation

- Participation of ecoda in environmental studies in Egypt
- Possible impacts of wind turbines on environment: landscape, social aspects, local fauna and flora
- Bird migration in Egypt (Gulf of Suez, Nile Valley)
- Possible impacts of wind turbines on migrating birds
- Examples for impact assessment
- Mitigation measures, post-construction monitoring

JV Li - ecoda

Participation of ecoda or JV Lahmeyer / ecoda in Environmental Studies in Egypt

2007	Post-construction monitoring (on migrating birds) at Zafarana wind farm (Gulf of Suez)
2007	Investigation on possible impacts of wind farms at Gulf of Zayt on migrating birds as part of a feasibility study
2008	Additional investigation on migration birds at Gulf of Zayt
2010	Full environmental impact assessment for wind farms in a 200 sqkm area west of Ras Gharib (Gulf of Suez)
2011	Investigation on the impact of wind farms on migrating birds at the West Nile Valley
2012	Full environmental impact assessment for wind farms in a 300 sqkm northwest of Ras Gharib (Gulf of Suez)

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Possible impacts of wind turbines on environment: visual and acoustical impact on landscape

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Possible impacts of wind turbines on environment:

impacts regarding social aspects

Generally no significant impact in the Egyptian desert !

Interests of Bedouins have to be considered!

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Possible impacts of wind turbines on environment:

local fauna and flora

local fauna and flora is poor in species, and density is very low

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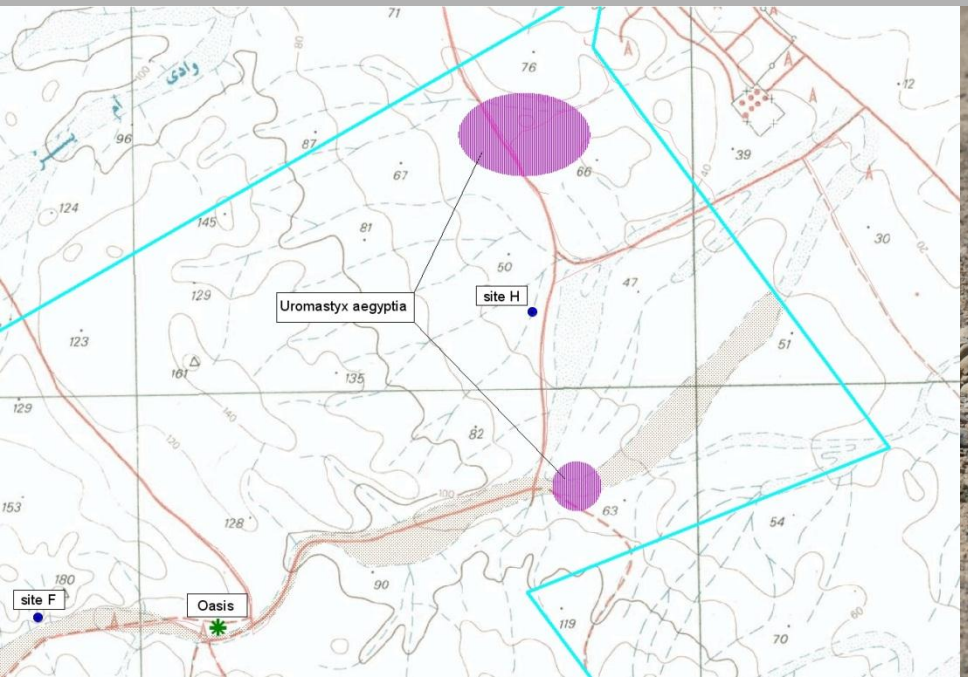
Possible impacts of wind turbines on environment: local fauna and flora

Generally no significant impact in the Egyptian desert !

Impacts during constructional phase are possible,
but easy to mitigate (example: burrows of Egyptian Dabb Lizard)



General idea of bird migration

- Three main African-Eurasian flyways
- "Middle East"-flyway the most important one for a number of species
- Gulf of Suez is a very important part of the "Middle East"- flyway

by Dr. Y. Leshem

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Bird migration at the Gulf of Suez: Available information

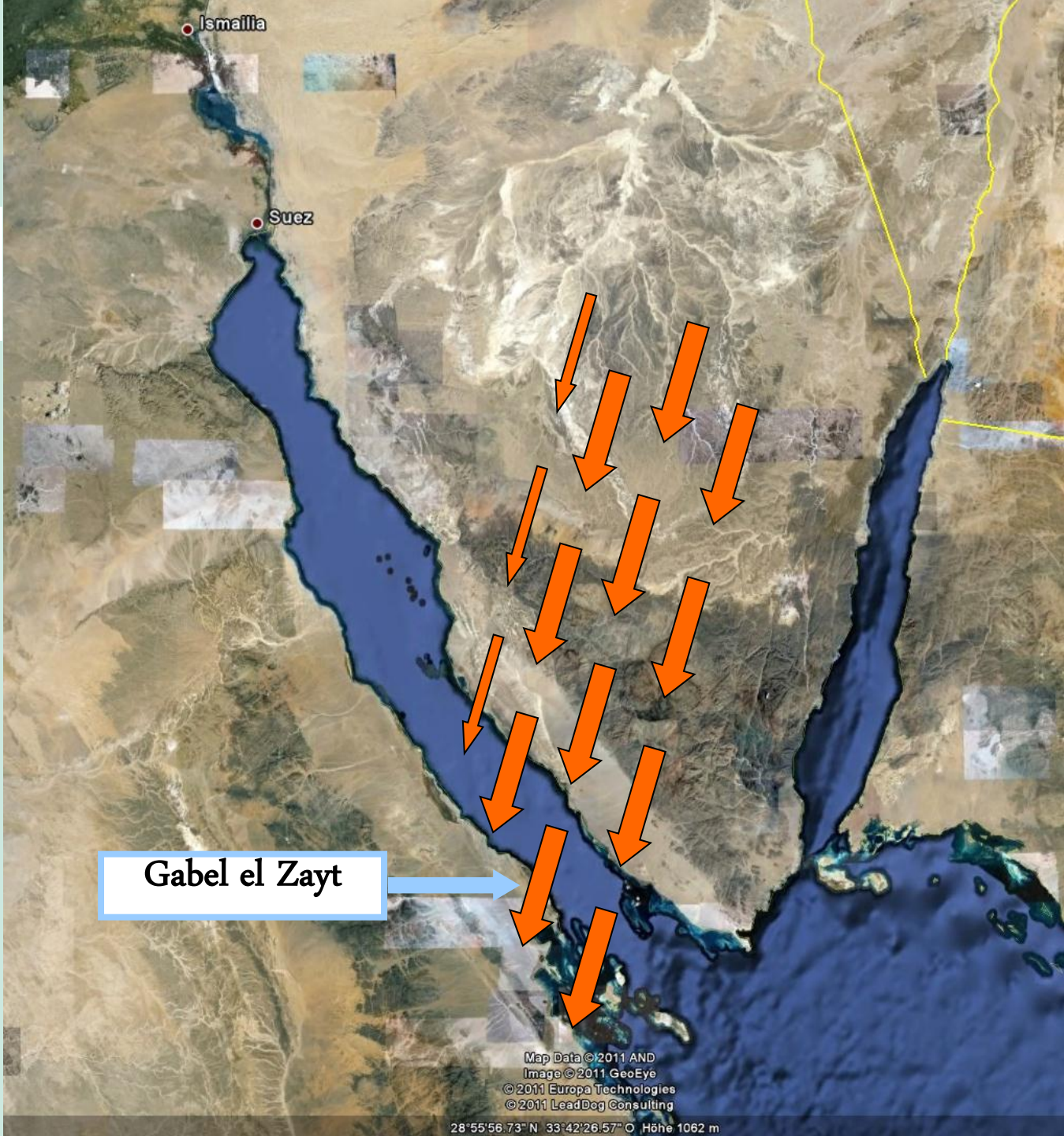
- Studies conducted at the Gulf of Suez:
  - Biebach & Baha El Din 1995
  - Baha El Din 1996, 1999
  - Ornis Consult 2002
  - CarlBro 2008
  - Hilgerloh 2009
  - Bergen 2007, 2009, 2011

- General relevant studies about bird migration:
  - Meyburg *et al.*: studies on migration of birds of prey
  - Berthold *et al.*: studies on White stork migration
  - Hötker *et al.*: studies on White stork migration

Cairo – September 11th, 2012

Bird migration at Gulf of Suez

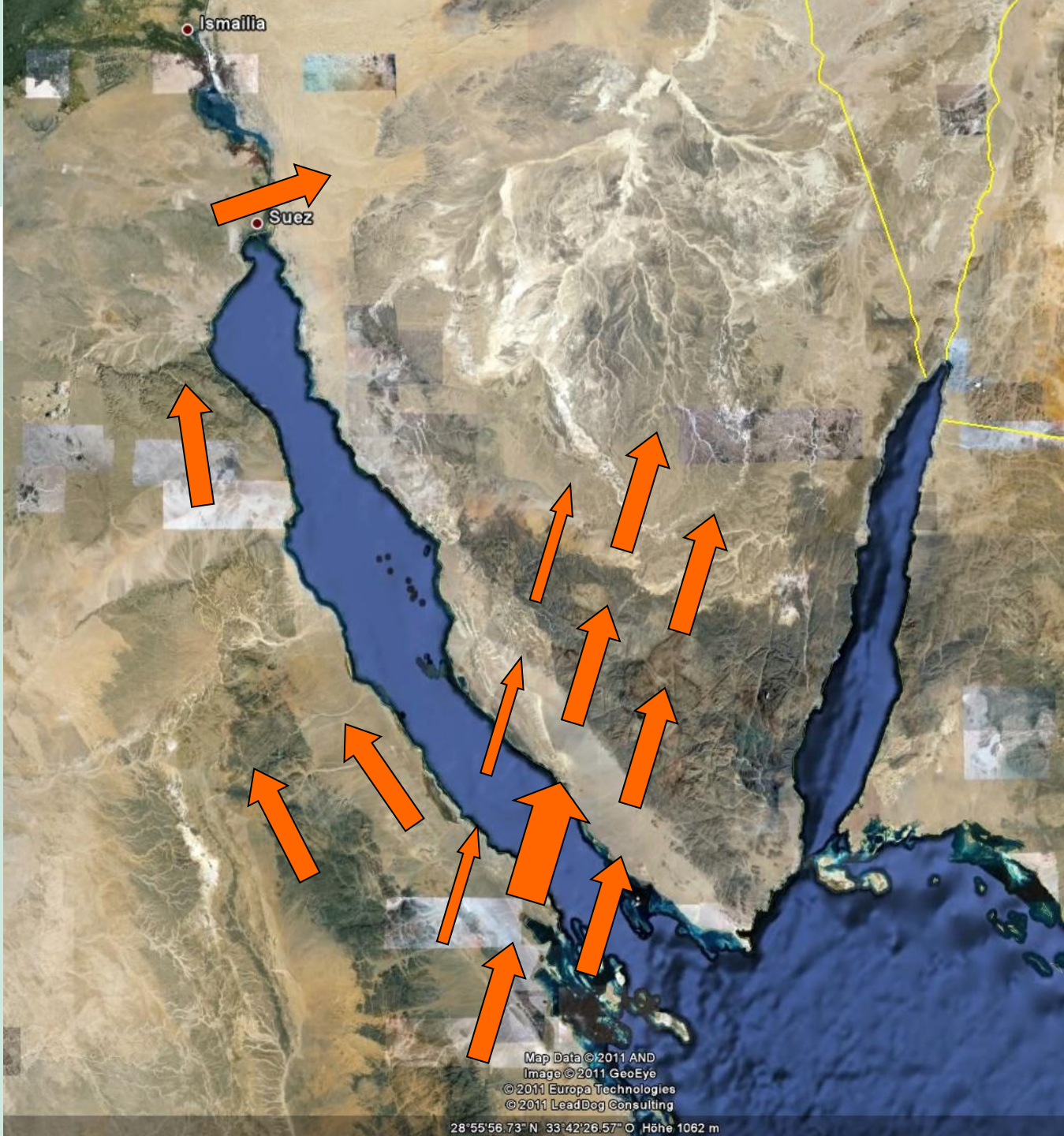
Schematic figure: migration of White stork, Honey buzzard and other species in autumn



Cairo – September 11th, 2012

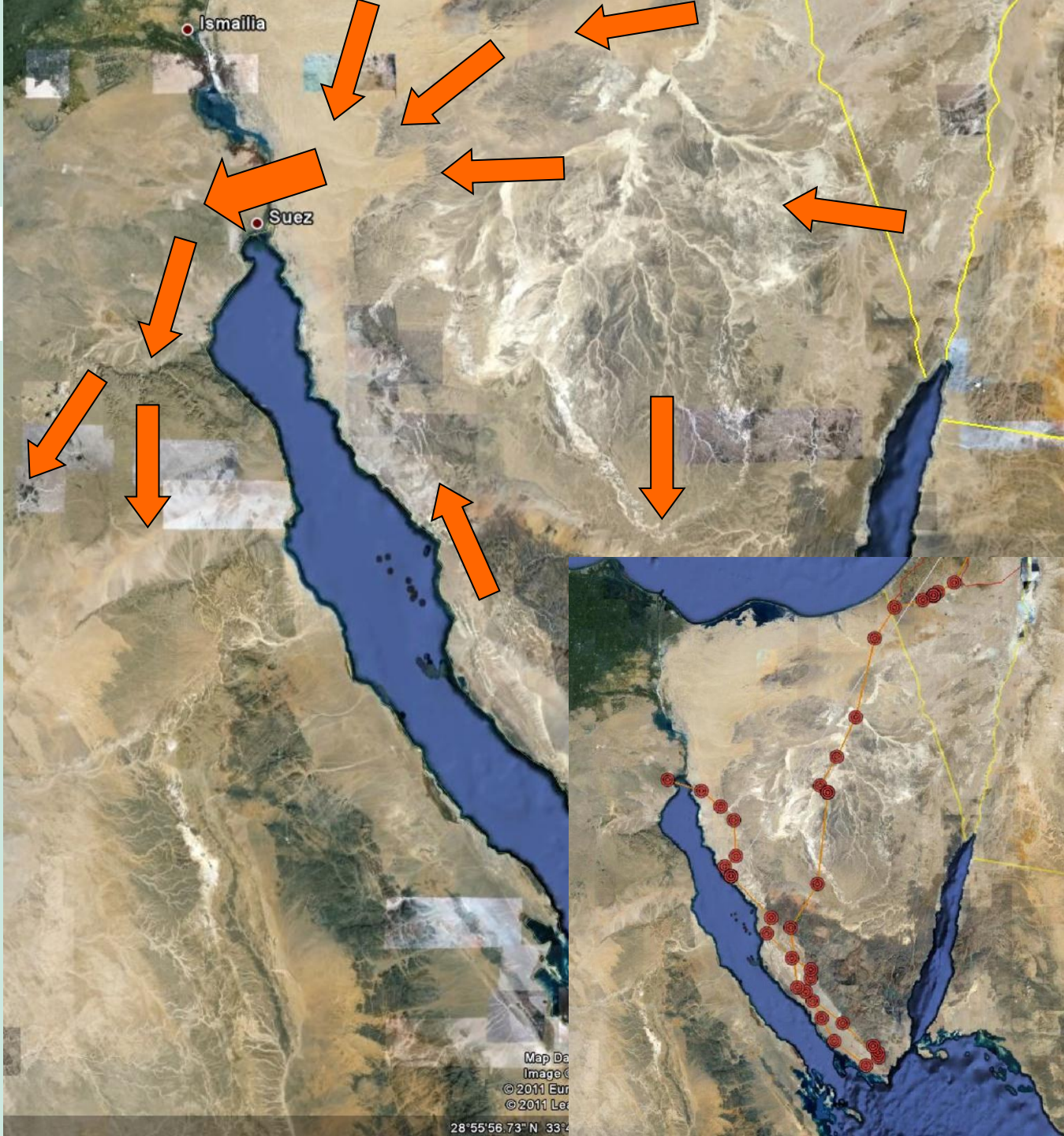
Bird migration at Gulf of Suez

Schematic figure: migration of White stork, Honey buzzard and other species in spring



Bird migration at Gulf of Suez

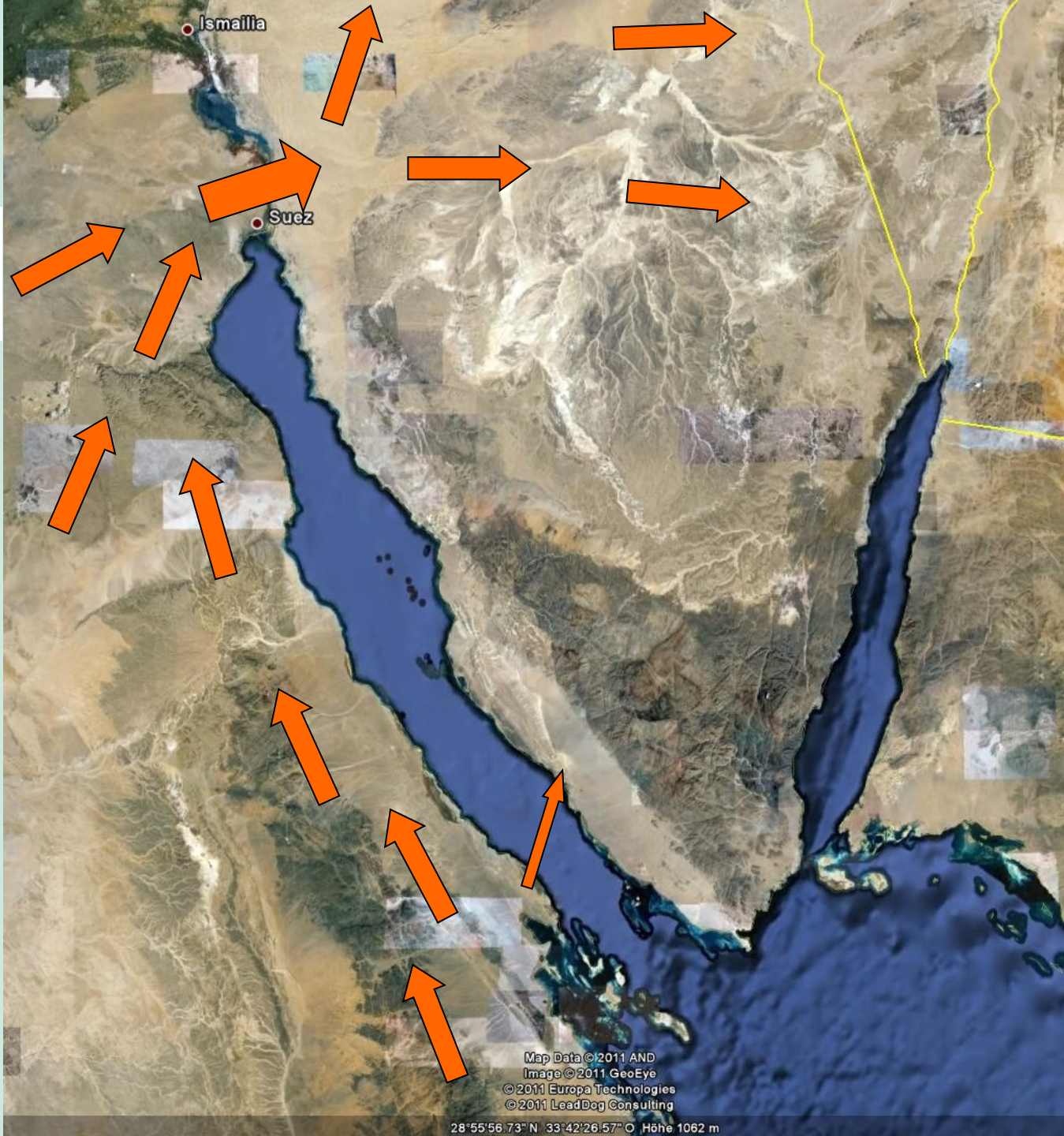
Schematic figure: migration of Eagles and other birds of prey in autumn



Cairo – September 11th, 2012

Bird migration at Gulf of Suez

Schematic figure: migration of Eagles and other birds of prey in spring



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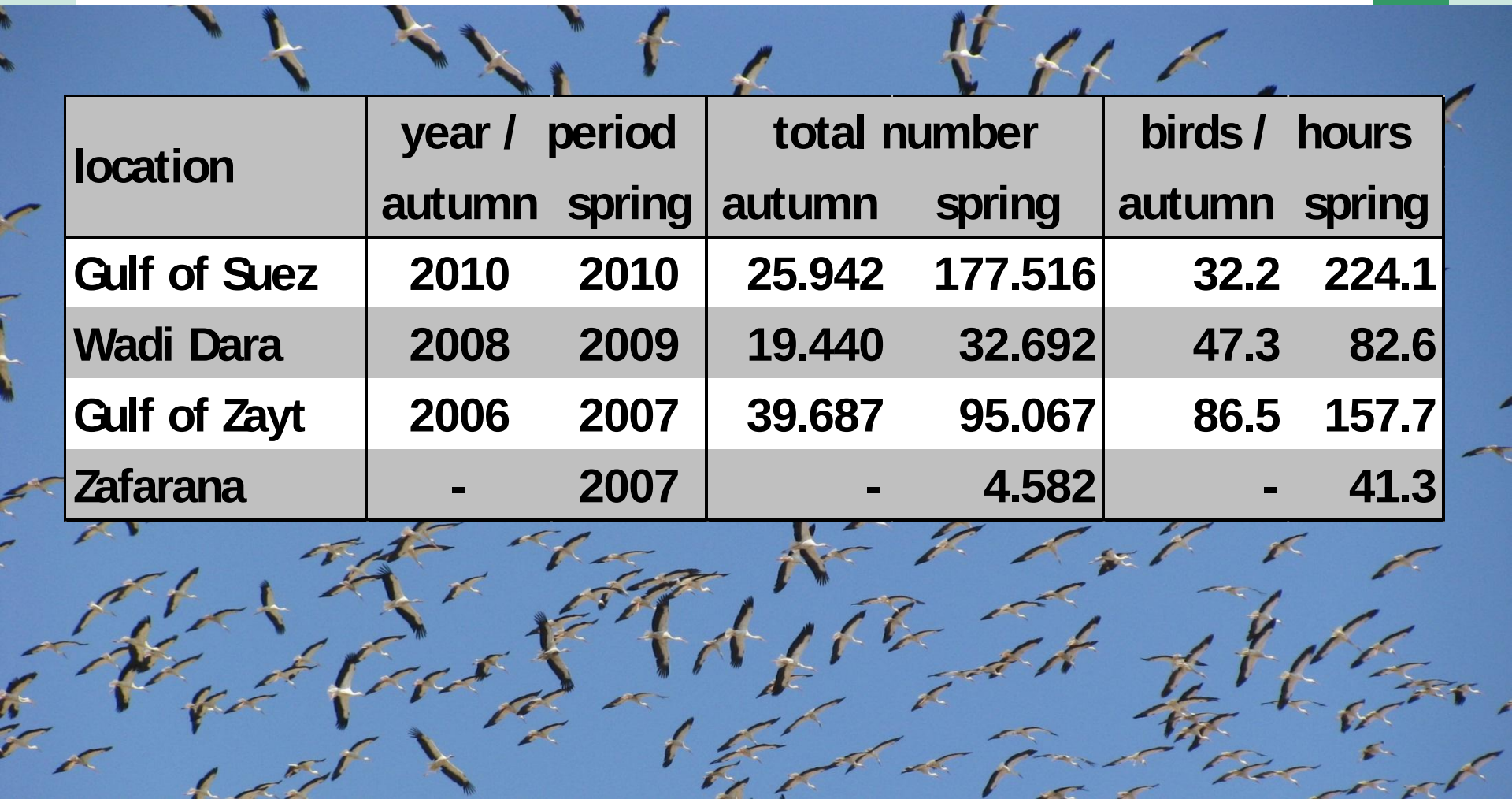
- Bird migration at Gulf of Suez:

  Exemplary results from previous investigations



location	year / period		total number		birds / hours	
	autumn	spring	autumn	spring	autumn	spring
Gulf of Suez	2010	2010	25.942	177.516	32.2	224.1
Wadi Dara	2008	2009	19.440	32.692	47.3	82.6
Gulf of Zayt	2006	2007	39.687	95.067	86.5	157.7
Zafarana	-	2007	-	4.582	-	41.3

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- Bird migration at Gulf of Suez & West Nile Valley:

  Exemplary results from previous investigations

location	year / period		total number		birds / hours	
	autumn	spring	autumn	spring	autumn	spring
Gulf of Suez	2010	2010	25.942	177.516	32.2	224.1
Wadi Dara	2008	2009	19.440	32.692	47.3	82.6
Gulf of Zayt	2006	2007	39.687	95.067	86.5	157.7
Zafarana	-	2007	-	4.582	-	41.3
Nile Valley	2011	2012	65	57	0.06	0.06

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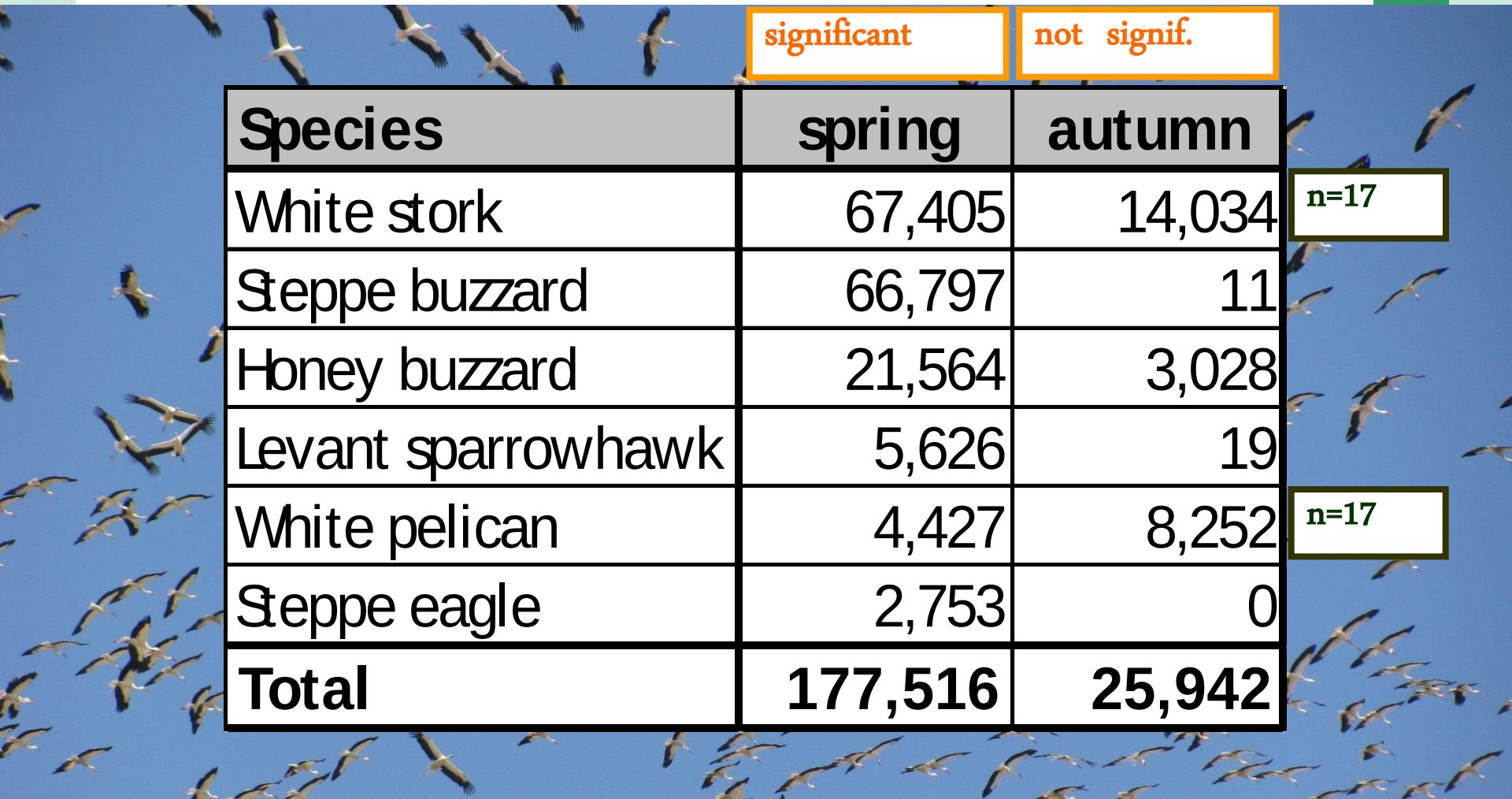
- **Bird migration at Gulf of Suez & West Nile Valley:**

  Exemplary results from previous investigations



	significant	not signif.	
Species	**spring**	**autumn**	
White stork	67,405	14,034	n=17
Steppe buzzard	66,797	11	
Honey buzzard	21,564	3,028	
Levant sparrowhawk	5,626	19	
White pelican	4,427	8,252	n=17
Steppe eagle	2,753	0	
Total	**177,516**	**25,942**	

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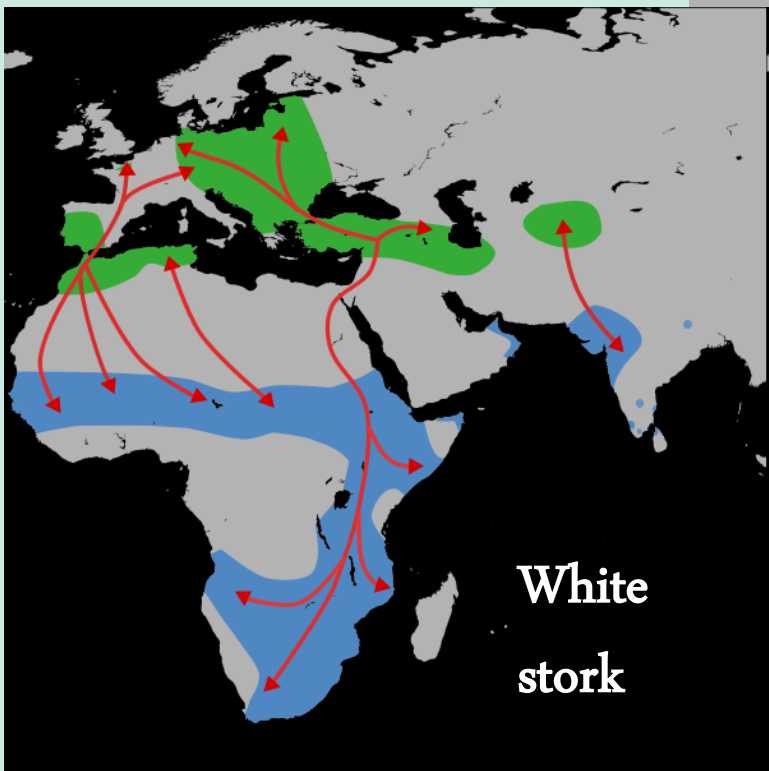
Assessing the importance of an area:
Criteria developed by Birdlife International

- Areas of international importance:
  - Area where at least 20.000 storks, raptors or cranes regularly pass during spring or autumn migration
  - Area that regularly hold at least 1% of a flyway population of a threatened migratory species

Definition:

A flyway population, is a population of a species sharing the same migration route linking breeding areas (green) and wintering areas (blue)



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Assessing the importance of an area

Flyway population and conservation status (spring 2010)

Species	Ind.	% of Flyway Population		Global (IUCN)	SPEC (Europe)
White stork	67,405	!!!	15.5	Least Concern	unfavourable
Levant sparrowhawk	5,626	!!	7.5	Least Concern	unfavourable
Steppe eagle	2,753	!!	7.3	Least Concern	unfavourable
White pelican	4,427	!!	6.3	Least Concern	unfavourable
Booted eagle	189	!!	6.0	Least Concern	unfavourable
Steppe buzzard	66,797	!!	5.3	Least Concern	-
Short-toed eagle	396	!	4.5	Least Concern	unfavourable
Black stork	625	!	3.2	Least Concern	unfavourable
Egyptian vulture	142	!	3.1	Endangered	unfavourable
Honey buzzard	21,564	!	2.2	Least Concern	-
Common crane	593	!	1.7	Least Concern	unfavourable
Black kite	2,208	!	1.7	Least Concern	unfavourable
Lesser spotted eagle	568	!	1.1	Least Concern	unfavourable

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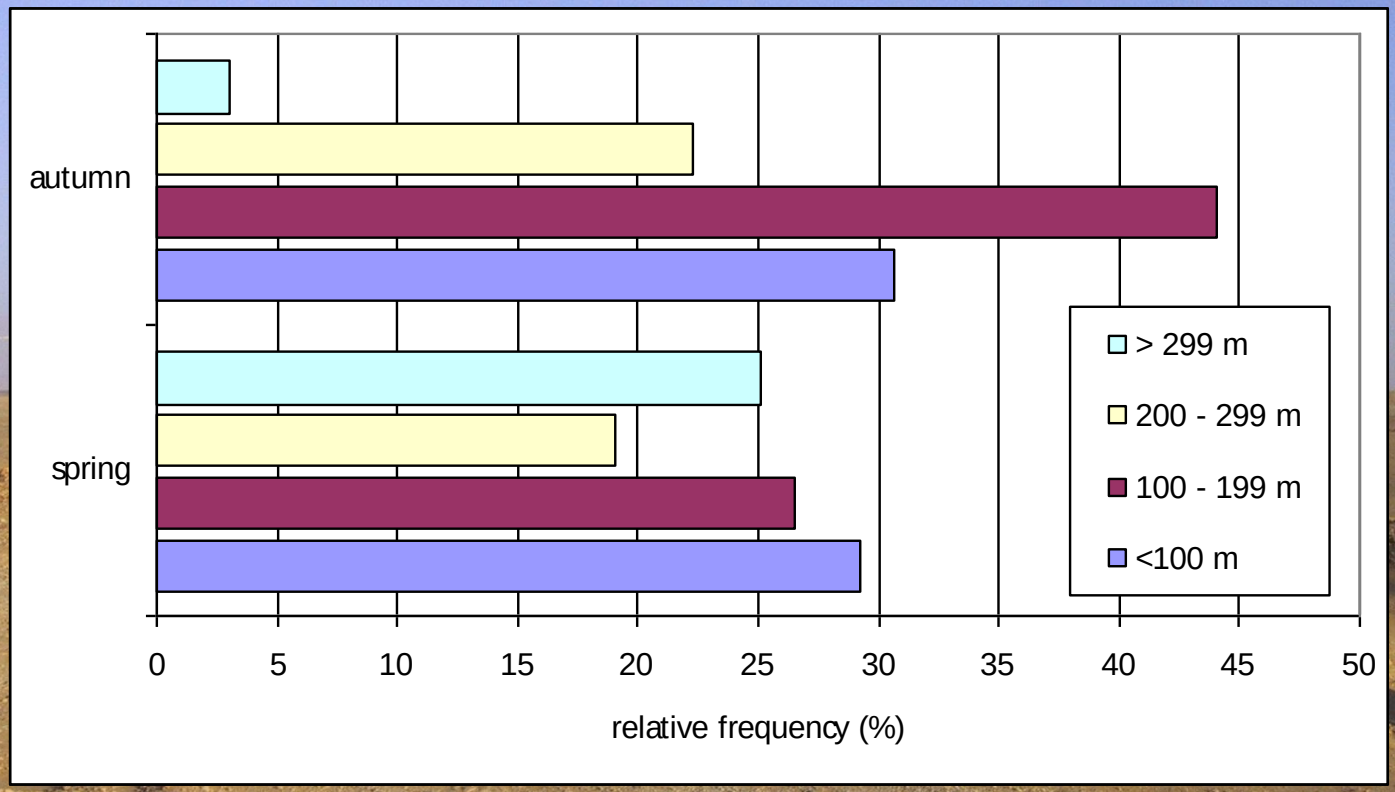
- Possible impacts of wind turbines on birds:

  Flight altitudes a crucial factor (results from 2010)

- About a third of all birds migrated lower than 100 m

  Significant impacts cannot be excluded



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Possible impacts of wind turbines on birds:
Collision risk – available information

- U.S. (Erickson *et al.* 2001):
  - 2.19 birds per turbine per year
  - 0.033 raptor fatalities per turbine per year

Results and conclusion not directly applicable for wind farm developments at the Gulf of Suez

- Collision risk is depending on a number of factors (characteristics of a site, bird abundance, species-specific factors)



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- **Possible impacts of wind turbines on birds:**

  Results from Zafarana wind farm (ecoda 2007)

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- Possible impacts of wind turbines on birds:

  Results from Zafarana wind farm

- No fresh bird corpses were found at 220 wind turbines

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Possible impacts of wind turbines on birds: Species-specific collision risk

- Passive fliers: most vulnerable to collision risk (*e.g.* Egyptian vulture, other Eagles)

- Less passive fliers: vulnerable to collision risk (*e.g.* Storks, Pelicans, Long-legged buzzard)
- More or less active fliers: less vulnerable to collision risk (*e.g.* Harriers, Falcons)

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- Possible impacts of wind turbines on birds:

  Barrier effects – results from Zafarana

- Species-specific differences:
  - Steppe buzzard seem to regard the whole wind farm as a barrier, Black kites and Harriers did not
  - White stork, Honey buzzard, Steppe eagle ???

- Barrier effects of single wind farms are not believed to have significant impacts on populations

  (but: cumulative effects cannot be excluded)

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Possible impacts of wind turbines on birds:

Impact assessment difficult due to lack of knowledge

- No experiences with similar wind farms due to the unique site characteristics

- Frequency and significance of collisions not accurately predictable
- Cause and effect chain of collision poorly understood
- Significance of barrier effects not accurately predictable
- No experiences with regards to cumulative effects

→ Careful development of wind farms at the Gulf of Suez is highly recommended (applying precautionary principle):

- Maintaining mitigation measures to reduce impacts
- Urgent need for post-construction monitoring programme

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- Options to mitigate impacts

- Modification of siting of wind farms / wind turbines
- Modification of turbines and other related structures
- Modification of operation of wind farms / wind turbines
- Other mitigation measures

  (*e.g.* avoid establishing areas that would attract migrating birds)

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- **Options to mitigate impacts:**

  Modification of siting of wind farms / wind turbines

- **Avoid critical areas, i.e. areas with very high migratory activity at altitudes below 200 m of species that are of conservational concern**

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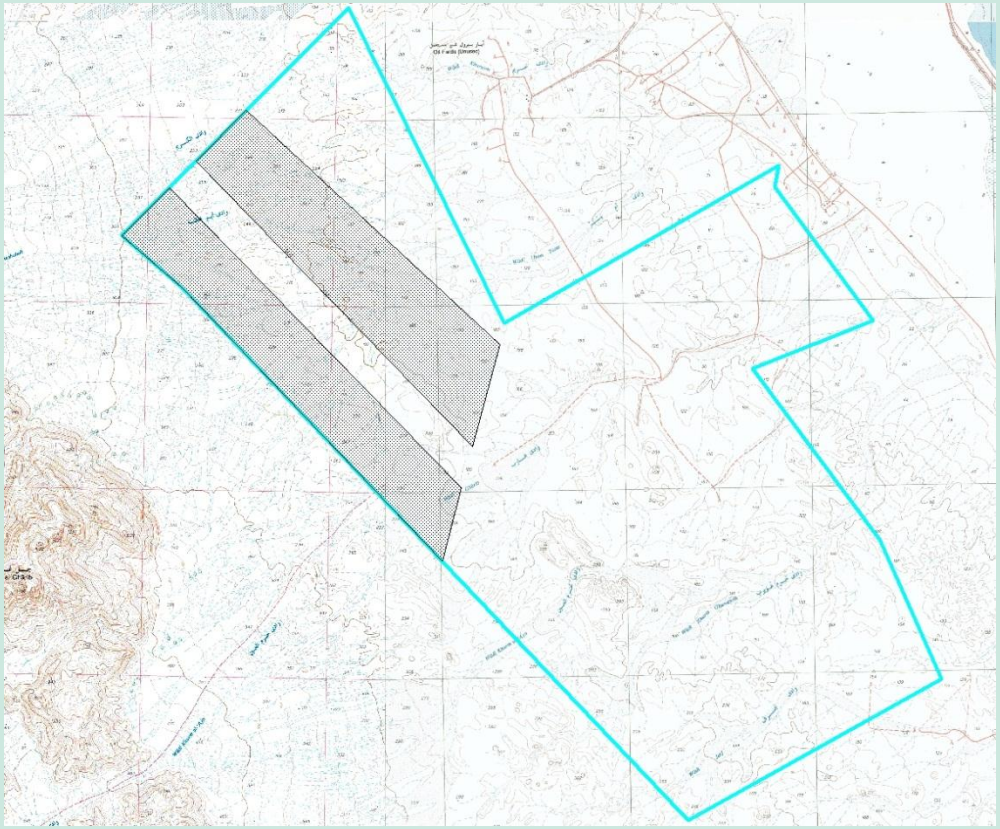
- **Options to mitigate impacts:**

  Modification of siting of wind farms / wind turbines

- **Maintain escape corridors parallel to main wind direction**



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Options to mitigate impacts:

Modification of turbines and other related structures

- Avoid / minimize lighting of turbines
  (lighting might attract birds, mainly passerines during nights)
- Limit total tip height to about 120 m
- Paint turbine blades to increase blade visibility (*e.g.* Hodos 2003)
- Avoid lattice towers
  (lattice towers might attract birds to rest or perch on towers)
- Build internal grid of wind farms by underground cables
- Design overhead power lines according to available guidelines
  ("Protecting birds from power-lines")

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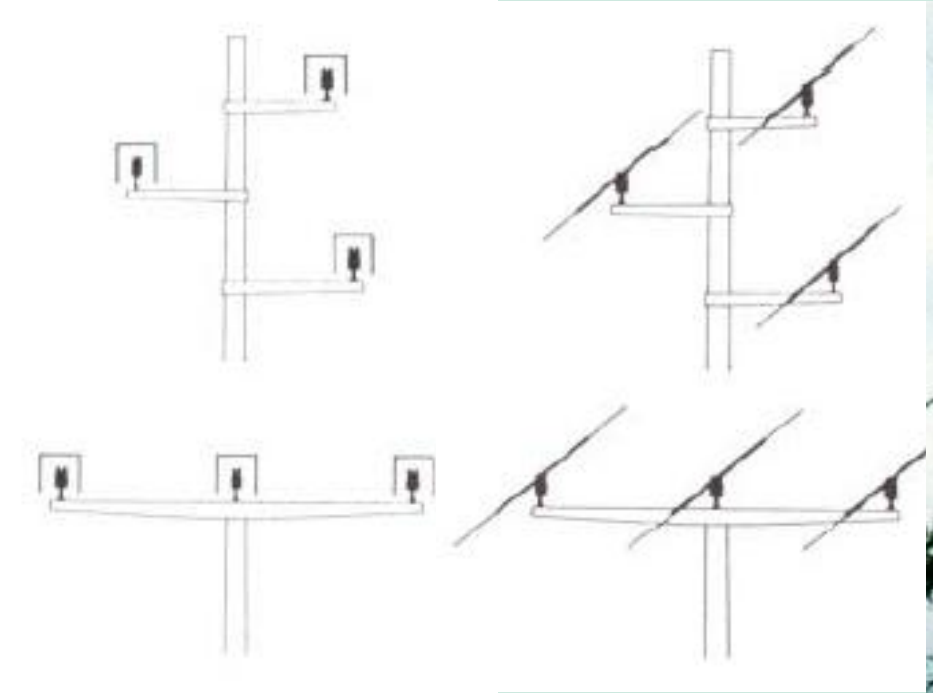
- **Options to mitigate impacts:**

  Excursion: overhead power lines

- **Install insulating caps/ hoods on medium-tension power poles in order to avoid electrocution**



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- **Options to mitigate impacts:**

  Excursion: overhead power lines

- Mark power lines in order to increase conspicuousness of power lines and to decrease collision risk (*e.g.* with "bird flappers")

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Options to mitigate impacts:

Modification of operation of wind farms / turbines

- Assumption:

  Non-operational turbines have minor effects on migrating birds (at least with regard to collision risk)

- <u>Scenario I ("worst case"):</u>

  - Shutdown of all turbines during the relevant migration period (here: March 1st to May 18th) during daytime (*e.g.* 1 h after sunrise to 1 h before sunset)
  - Supervision and central control of programme required

Calculated energy loss

i) wind data of 2010: 9.55 %

ii) long term wind data (10a): 9.13 %

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Options to mitigate impacts:

Modification of operation of wind farms / turbines

- Scenario II: ("shutdown on demand")

Shutdown of all turbines in times of

a) high migratory activity (1. Criterion)

and

b) large flocks approaching the wind farm (2. Criterion)

Bird monitoring required (from March 1st to May 18th):

- Ornithologists define times of shutdown if a criterion is met
- Ornithologists should stay in close contact with engineers
- Shutdown programme to be coordinated with the national Load Dispatch Center

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- Options to mitigate impacts:

  Modification of operation of wind farms / turbines

- Scenario II: ("shutdown on demand")

  Loss of energy output was calculated on the basis of the bird monitoring results obtained in spring 2010:

  1. Criterion (high migratory activity):

     migration rate > 200 ind./h at distance up to 2.5 km to a site

     → shutdown turbines for a period of 3 h (obs. unit)

  2. Criterion (large flocks approach the wind farm):

     a flock of > 200 ind. was recorded within the study area

     → shutdown turbines for a period of 3 h (obs. unit)

  Procedure is conservative because the period (3 h) is quite long.

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- **Options to mitigate impacts:**

  Modification of operation of wind farms / turbines

- Results of Scenario II ("shutdown on demand"):
  - Critical migration rate of > 200 ind./h in 44 observation units (24 %)
  - Covering 80 % of all migrating birds: 134.619 individuals
  - 1. Criterion → temporary shutdown of 144 h (on 32 days)
  - 2. Criterion → temporary shutdown of 54 h (additionally)
  - Total period of shutting down turbines: 198 h

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- Options to mitigate impacts:

  Modification of operation of wind farms / turbines

- Results of Scenario II ("shutdown on demand"):

Calculated energy loss

i) wind data of 2010: 1.90 %

ii) long term wind data (10a): 2.13 %

Scenario II seems to be an effective mitigation measure:

- impact will be minimized for a significant amount of birds
- energy loss seems to be acceptable

But: Reasonable siting of wind farms is still crucial!

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Post-construction monitoring programme

Objectives

- Examination of bird-wind turbines interactions:
  - Identify frequency and assess significance of collisions
  - Identify conditions in which collisions occur
  - Identify species-specific vulnerability
  - Describe behaviour of birds in the vicinity of turbines
  - Assess the (species-specific) significance of barrier effect
- Verify assumptions made in the impact assessment
- Test effectiveness of mitigation measures (*e.g.* painting blades)
- Identify possible critical wind turbines and -if necessary- define further operational mitigation measures
- Identify impacts (*e.g.* collision risk) at associated power lines

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Post-construction monitoring programme

First thoughts on appropriate methods

- Regular and standardized search for collision victims
  in the vicinity of selected turbines (*e.g.* Bevanger *et al.* 2010)
  (consider scavenger rate, search efficiency etc.)

- Visual observation to identify species-specific behaviour and vulnerability (Hoel 2009; BioConsult SH 2010)
  (probably assisted by automatic video recording)

- Radar based observations to accurately identify flight paths
  (*e.g.* Desholm 2006)

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Summary

- Environmental issues have been considered thoroughly in wind energy development in Egypt

→ with regards to landscape, social aspects or local fauna and flora impacts were not significant and / or easy to mitigate

→ impacts on migrating birds can not be excluded when building wind farms at the Gulf of Suez

→ careful development is crucial (precautionary principle)

→ options for mitigating impacts are available

→ urgent need for post-construction monitoring programmes:
might lead to further wind farm development
if impacts turn out to be negligible or easily to mitigate


Thank you very much for your attention!