

## Kurze Mitteilungen

### Reactions of Grey Herons (*Ardea cinerea*) to Seismic Tremors

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YOSEF, R. (1997): Reactions of Grey Herons (*Ardea cinerea*) to seismic tremors. *J. Orn.* 138: 543–546. — Earthquakes are usually a matter of seconds and while experiencing the phenomenon few observe the behaviour of the animals during the phenomenon. On 22 November 1995, at 06:16 hrs Israel Standard Time, an earthquake of a magnitude ( $M_w$ ) of 7.2 on the Richter scale shocked Eilat, Israel. I first observed unusual behaviour at about 06:00 hrs when flocks of several avian species flew north. Also, a flock of about 50 Grey Herons (*Ardea cinerea*), that roosted on the salt pans, became increasingly restless and eventually took to the air at 06:08 hrs. Our primary objective was to describe the sensitivity exhibited by the flock of Grey Herons to the tremors which continued to occur for weeks after the initial shock. Observers remained at the salt pans for a week after the initial shock and noted if flock members displayed any physical discomfort (e.g., shaking wings, jumping or hopping without lift off) during the day, and prior to flying off, owing to no reasonable disturbance. Subsequently, the Seismology Division, Institute for Petroleum Research and Geophysics supplied data of tremors recorded for the same period. A total of 37 tremors of  $M_w = 3.9$  or more were recorded. Majority of the tremors were  $M_w = 4.1$ , but an equal number of 4.4 and 4.5 combined were also recorded. Grey Herons reacted at all levels, although they appeared to ignore some tremors that were less than  $M_w = 4.2$ . However, the Herons took to the air when tremors were stronger than  $M_w = 4.3$ . Human observers partially felt tremors between the magnitudes of  $M_w = 4.1$  to 4.4, but all stronger tremors were felt. One of the interesting and consistent observations was that the birds showed the first signs of restlessness about 30–60 seconds prior to the human observers ability to feel the tremors.

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Studies of wildlife following natural meteorological or geological catastrophies are rare and are mostly restricted to the aftermath (e.g., WEAVER 1986, SHEPHERD et al. 1986, WILEY & WUNDERLE 1993, SCHMITZ & BALDASSARREE 1992). Earthquakes are usually a matter of seconds and while experiencing the phenomenon few have the chance to observe, or attempt to report afterwards, the behaviour of the animals during the phenomenon. We found only four previous studies of the reactions of birds to earthquakes — two published in Russian (SIDORIN 1993, NIKONOV 1994) and two in Chinese (JIANG et al 1994, XU et al 1994).

#### Situation

On 22 November 1995, at 06:16 hrs Israel Standard Time (+2 h UT), an earthquake shocked Eilat, Israel (29°33'N, 34°57'E) which is located at the northernmost point of the Red Sea. The earthquake magnitude ( $M_w$ ) measured  $M_w = 7.2$  (or 6.3 on the local Richter scale) and was

approximately 100 km to the south (28°54'N, 34°75'E) in the Gulf of Aqaba at a depth of about 10 km (Seismology Division, The Institute for Petroleum Research and Geophysics). The earthquake was strongly felt in Israel, Jordan, Egypt, and Saudi Arabia and damage occurred at settlements along the gulf shores. This strong earthquake was followed by thousands of smaller shocks, several tens of them were strong enough to be felt in an area of a radius of several tens of kilometers. This intensive seismic activity has continued for several months and although the seismicity in the epicentral area is subsiding, occasional earthquakes are still recorded and/or felt by the residents of the region (AVI SHAPIRA, pers. comm.).

Eilat is well known amongst ornithologists as an important avian migratory bottleneck of the Palearctic (SAFRIEL 1968, SHIRIHAI & CHRISTIE 1992, YOSEF 1995). In November, at the end of the autumn migration season, many late migrants are still present. The occurrence of the earthquake, and the subsequent aftershocks, while trapping and ringing migrant birds allowed observation of their behaviour before, during, and after the earthquake (YOSEF 1996).

### Results and Discussion

We first observed unusual behaviour at about 06:00 hrs when flocks of several hundred gulls (*Larus* spp.), and several other species (e. g., Pied Kingfisher, *Ceryle rudis*, European Kingfisher, *Alcedo atthis*, Cormorant *Phalacrocorax carbo*) flew north. It is unusual in our area to see gulls moving in such numbers, so early in the morning, in a northerly direction in autumn. We also observed a flock of about 50 Grey Herons (*Ardea cinerea*), that had roosted less than 50 m from the ringing station on the salt pans, that became increasingly restless and eventually took to the air at 06:08 hrs. After taking off, the herons resorted to flapping flight and headed east and over the border into Jordan.

At 06:15h we felt the initial, and the strongest, of the shocks. The ringing station and the Sea Blite *Suaeda monoica* bushes started to sway strongly forcing the birds in them to take to the air. These birds (Chiffchaffs, *Phylloscopus collybita*, Bluethroats, *Luscinia svecica*, Redstarts, *Phoenicurus phoenicurus*, Spanish Sparrows, *Passer hispaniolensis*, and Little-green Bee-eaters, *Merops orientalis*) hovered above the vegetation until the tremors passed at about 06:25 hrs and the bushes stopped swaying. During this time, at 06:18 hrs, loud reports were heard and large clouds of dust seen in the air to the east, less than 75 m in the direction of the Jordanian-Israeli border. We later understood that we had experienced the friction between the Saudi Arabian Peninsula and the Mediterranean side of the tectonic plates.

Observations of wildlife behaviour during earthquakes are rare. Therefore, our primary objective was to describe the sensitivity exhibited by the flock of Grey Herons to the tremors which continued to occur for weeks after the initial shock. We limited our observations to daylight hours (05:30–17:00 h), and from 22 November till 3 December 1995.

Volunteers of the International Birding Center in Eilat (IBCE) remained at the salt pans during the first two days and then the Municipality of Eilat supplied an observer for the rest of the week. Each observer sat at a distance of approximately 50 m from a flock of Grey Herons that rested during the day and roosted at night in the salt pans. Observers timepieces were synchronized to Israeli Standard Time prior to beginning their observations. Each observer noted if flock members displayed any physical discomfort (e. g., shaking wings, jumping or hopping without lift off) during the day, and prior to flying off, owing to no visible or reasonable disturbance. We considered a reasonable disturbance as one caused either by the approach of a vehicle, joggers, people walking their dogs, or natural disturbances like the presence of raptors in the vicinity. Subsequently, A. SHAPIRA, Seismology Division, Institute for Petroleum Research and Geophysics (IPRG) supplied the data of tremors recorded.

During the 10 days of our study, although thousands of minor tremors were recorded every day and night at the IPRG (unpubl. data), we took into account only those stronger than  $M_w = 3.9$  on the richter scale because previous experience in the region has shown that animals do not react to these "minor" tremors. A comparison of our data (Table) also validates our assumptions. In a few instances, when subsequent tremors were close together in time, and if the Grey Herons had reacted to an earlier tremor and flown off, an "X" was noted to indicate their absence (Table).

Sensitivity of Grey Herons and their human observers to seismic tremors at Eilat, Israel. (Y) denotes a reaction, (N) no reaction, and (X) not present. Numbers in parentheses are percentages.

Magnitude (Richter scale)	Number recorded	Grey Herons	Humans
3.9	1 ( 2.7)	Y	N
4.0	4 (10.8)	1Y, 2N, 1X	4N
4.1	9 (24.3)	2Y, 6N, 1X	3Y, 6N
4.2	4 (10.8)	2Y, 1N, 1X	4N
4.3	3 ( 8.1)	2Y, 1X	1Y, 2N
4.4	5 (13.5)	5Y	3Y, 2N
4.5	4 (10.8)	4Y	4Y
4.6	2 ( 5.4)	2Y	2Y
4.7	1 ( 2.7)	1Y	1Y
4.9	2 ( 5.4)	2Y	2Y
5.0	1 ( 2.7)	1Y	1Y
6.2	1 ( 2.7)	1Y	1Y

A total of 37 tremors of the magnitude of  $M_w = 3.9$  or more were recorded. The majority of the tremors were of  $M_w = 4.1$ , but an equal number of 4.4 and 4.5 combined were also recorded (Table). Grey Herons reacted at all levels, although they also appeared to ignore some of the tremors that were less than  $M_w = 4.2$  in magnitude. However, the Herons took to the air when the tremors were stronger than  $M_w = 4.3$ , but on no occasion did the flock abandon the study area. Human observers partially felt the tremors between the magnitudes of  $M_w = 4.1$  to 4.4, but all stronger tremors were felt. One of the interesting and consistent observations was that the birds showed the first signs of restlessness about 30–60 seconds prior to the human observers ability to feel the tremors.

Our results suggest that Grey Herons are significantly (Mann Whitney U-test,  $U_{33,36} = 60$ ,  $z = -2.244$ ,  $P = 0.0245$ ) more sensitive to tremors of lower magnitudes than humans. Grey Herons do not appear to be overly alarmed by the tremors and escape the abnormal by flying into the air but remaining in the vicinity for 10–20 minutes. This also suggests that Grey Herons may be aware of earthquakes as a natural, and temporary, phenomenon that does not last for long periods of time.

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