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NORTHBOUND MIGRATION COUNT OF RAPTORS AT TANJUNG TUAN, PENINSULAR MALAYSIA: MAGNITUDE, TIMING, AND FLIGHT BEHAVIOR

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Abstract.—Tanjung Tuan is a primary spring raptor migration watchsite in Malaysia. During northbound migration, many raptors can be seen crossing the Straits of Malacca from Sumatra (Indonesia) to Peninsular Malaysia. We examined the migration magnitude, timing, and flight behavior of migratory raptors recorded based on migration counts at Tanjung Tuan in 2009 and 2010. A total of 37 615 migrating raptors of 11 species and 72 277 individuals of 10 species were counted in 2009 (332 hr of observation) and 2010 (465 hr), respectively. Eighty percent of bulk passage occurred in 29–38 d, with the average median passage date occurring in mid-March. Oriental Honey-buzzard (*Pernis ptilorhyncus*) made up 85.9 ± 2.9% of the flight, followed by Black Baza (*Aviceda leuphotes*, 8.7 ± 3.8%) and Chinese Goshawk (*Accipiter soloensis*, 3.0 ± 2.0%). The timing of the peak daily count differed among the three major migrants with highest count of Oriental Honey-buzzards occurring at 1200–1300 H, whereas for both Black Bazas and Chinese Goshawks, peak daily counts were at 1400–1600 H (when air temperatures were the highest). Most migration occurred during days when winds were from southwest and west. The difference in migration timing is believed to be associated with the species' flight behaviors, their preferred wind direction, and the availability of thermals. The height of flight for Oriental Honey-buzzards, which used both soaring and flapping flight during migration, was positively correlated with the hourly temperature (r = 0.241, P = 0.026). Results from migration counts made at Tanjung Tuan suggest that this watchsite captures a high proportion of migratory raptors (especially for Oriental Honey-buzzards) along the East Asian-Australasian flyway. Such information, together with count data collected from other watchsites, is essential for a better understanding of migratory raptors in this region and for effective conservation.

Key Words: *Oriental Honey-buzzard*; Pernis ptilorhyncus; *flight behavior*; *Malaysia*; *migration timing*; *migratory raptor*; *Tanjung Tuan*.

CONTEO MIGRATORIO CON DIRECCIÓN NORTE DE RAPACES EN TANJUNG TUAN, PENÍNSULA MALAYA: MAGNITUD, TIEMPOS Y COMPORTAMIENTO DE VUELO

Resumen.—Tanjung Tuan es uno de los principales sitios de avistamiento de la migración primaveral de rapaces en Malasia. Durante la migración con dirección norte, se pueden observar muchas rapaces cruzando el Estrecho de Malacca desde Sumatra (Indonesia) hacia la Península Malaya. Examinamos la magnitud migratoria, los tiempos y el comportamiento de vuelo de rapaces migratorias registradas en conteos en Tanjung Tuan en 2009 y 2010. Un total de 37 615 rapaces migratorias de 11 especies y 72 277 individuos de 10 especies fueron contados en 2009 (332 hs de observación) y 2010 (465 hs), respectivamente. Ochenta por ciento del volumen del pasaje ocurrió en 29–38 días, con la fecha de pasaje mediano promedio ocurriendo a mediados de marzo. *Pernis ptilorhyncus* comprendió el 85.9 ± 2.9% de los vuelos, seguido por *Aviceda leuphotes* (8.7 ± 3.8%) y *Accipiter soloensis* (3.0 ± 2.0%). La hora de los conteos máximos diarios difirió entre las tres especies migratorias principales, con los conteos más altos de *P. ptilorhyncus* ocurriendo a las 1200–1300 H, mientras que para *A. leuphotes* y *A. soloensis* los conteos máximos diarios se dieron entre las 1400–1600 H (cuando las temperaturas del aire fueron las más altas). La mayoría de las migraciones ocurrieron en días en los que los vientos provinieron del sudoeste y del oeste. Se cree que la diferencia en los tiempos de migración está asociada con los comportamientos de vuelo de las especies, su preferencia por la dirección del viento y la

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disponibilidad de corrientes de aire ascendente. La altura de vuelo para *P. ptilorhyncus*, que utilizó tanto vuelos de planeo como de aleteo durante su migración, estuvo positivamente correlacionada con la temperatura de cada hora ($r = 0.241$, $P = 0.026$). Los resultados de los conteos migratorios realizados en Tanjung Tuan sugieren que este sitio de observación permite el registro de una elevada proporción de rapaces migratorias (especialmente para *P. ptilorhyncus*) a lo largo de la ruta de vuelo del este de Asia-Australasia. Esta información, junto con los datos de conteos registrados en otros sitios de observación, es esencial para un mejor entendimiento de las rapaces migratorias en esta región y para una conservación eficaz.

[Traducción del equipo editorial]

Because of seasonal changes in food sources and weather conditions in the northern hemisphere, many raptors make long-distance movements back and forth between breeding and wintering areas each year (Kerlinger 1989). The migration routes, magnitude, and timing may vary according to species. Such phenomena have encouraged the establishment of migration watchsites in many countries (Zalles and Bildstein 2000), particularly at places where birds congregate and can be seen easily. In the past, many migratory raptor watchsites were established as a result of concerns over human persecution of these birds (Bildstein 2006). Over the years, the fluctuations of raptors observed through long-term migration counts have helped researchers assess the status of species' populations, as well as understand the impacts of human activities (such as the use of agricultural chemicals) on migratory raptors (Bednarz et al. 1990), even when the number of migratory birds was small (Bildstein 1998). At present, there are nearly 400 migration watchsites in over 89 countries on six continents, with the highest densities found in Europe and North America, where monitoring can be dated back to the first half of the 20th century (Zalles and Bildstein 2000, Bildstein 2006).

There are 66 complete and partial migratory raptors on continental Asia (Zalles and Bildstein 2000, Yamazaki et al. 2012). At wintering or stopover sites, migratory raptors can be seen, often in large numbers, throughout many parts of Southeast Asia including Thailand, Vietnam, Malaysia, Indonesia, and the Philippines depending on their migration routes (Higuchi et al. 2005, Shiu et al. 2006, Yamaguchi et al. 2008, Germi et al. 2009). Over the last decade, there has been an increase in the number of migratory raptor watchsites (e.g., DeCandido et al. 2004a, 2008, DeCandido and Nualsri 2009) in Southeast Asia from which raptor count data are collected primarily by volunteers. Because of the counts and the increased local awareness, many watchsite locations have since become protected. Moreover, the establishment of the Asian Raptor Research and Conservation Network (ARRCN) exemplified joint efforts in studying and conserving the migratory and resident raptors in the region.

As part of the East Asian–Australasian flyway, Malaysia serves as both a wintering and stopover site for many migratory birds, including raptors. Tanjung Tuan is the most prominent watchsite in the country for counting migratory raptors that are heading northeast from Sumatra, Indonesia, in spring during their return migration. Like many other watchsites in different parts of the world (Bildstein 2006), Tanjung Tuan is a peninsula, which shortens overwater crossing for the migrating birds. Although the movement of migrants through Tanjung Tuan has been recognized since the 1950s, only a few published works with detailed accounts of the migration, most involving shorter observation periods, are available (DeCandido and Allen 2000, DeCandido et al. 2004b, 2006), whereas other data are in the form of observation reports (e.g., White 1961, Medway and Nisbet 1965, Wells 1990). We describe the magnitude and migration timing of migratory raptors as well as their flight behavior based on the annual standardized counts made at Tanjung Tuan in 2009 and 2010. Our study highlights the importance of maintaining migration counts and protecting these migration locations in Southeast Asia.

Methods

Study Site. Designated as an Important Bird Area (IBA), Tanjung Tuan (2°24.4′N, 101°55.3′E; Fig. 1) is a promontory of 95-m elevation that stretches out 1.2 km into the Straits of Malacca (Yeap et al. 2007). The rocky promontory is surrounded by the Tanjung Tuan Forest Reserve, a Virgin Jungle Reserve of 75.9 ha located in Melaka state on the southwestern coast of Peninsular Malaysia. The area has undulating terrain dominated by trees from the Myrtaceae family (Mat-Salleh et al. 2003) and receives an annual rainfall of 3230 mm with a mean temperature of 32°C.

The Rachado Lighthouse, built in 1890, stands at the tip of the promontory overlooking the Straits of

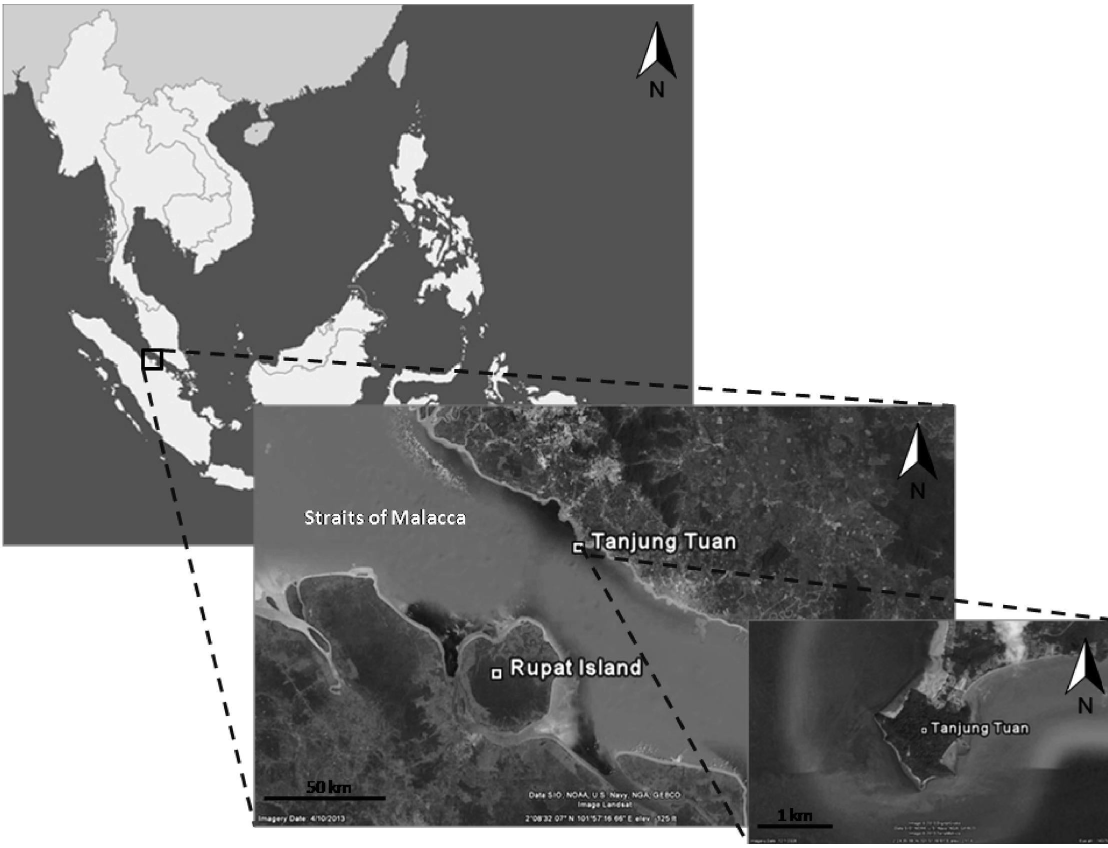

Figure 1. Location of Tanjung Tuan, Peninsular Malaysia (Google Earth, www.earth.google.com).

Malacca. The peninsula provides the shortest distance (ca. 38 km) for migrating raptors moving across the Strait between Sumatra (Rupat Island) and Peninsular Malaysia (Zalles and Bildstein 2000). In addition to other non-raptor migrants (DeCandido et al. 2004b), at least nine migratory raptor species are recorded at Tanjung Tuan each year (Yeap et al. 2007) including three complete migrants, i.e., Oriental Honey-buzzard (*Pernis ptilorhyncus*), Chinese Goshawk (*Accipiter soloensis*) and Grey-faced Buzzard (*Butastur indicus*).

In March 2000, the Malaysian Nature Society (MNS) organized the first Raptor Watch Week at Tanjung Tuan in response to a potential development threat to its forest habitat. Subsequently, Raptor Watch Week became an annual event to promote public awareness about the importance of the area as a stopover point for migrants. Since then, raptor counts have also been initiated by the MNS, with the main counters being volunteer birdwatchers. Over the years, the protocols of the migration count have been improved and standardized, and this has provided more information on the magnitude, timing, and seasonality of raptor migration at the site.

Migration Count. In 2009 and 2010, raptor migration counts were made from the Rachado Lighthouse from mid-February to mid-April, during which time congregations of migratory raptors were observed moving from the direction of Rupat Island to Tanjung Tuan. Prior to 2009, raptor counts were also made but these data were not included due to their relatively shorter count periods. Nonetheless, previous counts served as a pilot study to determine appropriate time for the full-season count (i.e., ideally, between 1 February to 30 April). Due to limitations in volunteer hours, we conducted the counts only from mid-February to mid-April for the two years. We considered them as nearly full-season migration counts as they covered the primary passage dates of all major migrants, based on the pilot study.

Daily migration count was conducted from 0900–1700 H, using 8–10× binoculars, 20–60× spotting scopes and a hand-held mechanical tally. When the birds were beyond the limit of binoculars, spotting scopes were used for both detection and species identification. When large flocks of birds flew over, bird numbers were estimated by mentally dividing the passing migrants in groups of ten or twenty. At Tanjung Tuan, flocking or ''kettling'' (*sensu* Bildstein 2006) often occurred in species such as Oriental Honey-buzzard. Counts were made when the birds passed a certain point (e.g., a ship or a buoy) or at the end of the ''kettling'' behavior when the birds start to move off (''streaming''). To detect the maximum numbers of birds, the number of count hours was extended due to late arrival of the migrants after 1700 H on certain days. However, such incidents only occurred occasionally as migration activity was typically low after 1700 H. In this report, we standardized count data and limited our analysis to data collected within the regular daily count period from 0900–1700 H to allow temporal comparisons. The mean observation time was 7.41 ± 0.07 (SE) hr per day.

At least two counters observed migration every day, with one experienced person who had previously counted at the site being the lead counter and the other being an assistant. The lead counter scanned along the horizon from which the raptors were approaching while the second counter assisted in counting and recording birds that were missed by the former. The lead counter was also responsible in ensuring the quality of the data while the other counter(s) helped to spot birds from different directions along the horizon. Similar standardized count protocols based on that of ARRCN (adapted from that of Hawk Migration Association of North America or HMANA; Bildstein et al. 2007) were applied throughout each season's count.

Continuous scanning for birds was mainly made across the Straits of Malacca toward the direction of Rupat Island from the lighthouse. Birds were considered migrants if they passed the ''fixed imaginary line'' along the Straits established at the watchsite from the immediate south to north of the lighthouse and continued to move north until they were out of sight. There were cases in which birds moved toward the north without crossing the imaginary line, presumably making landfall north of the lighthouse toward Port Dickson (DeCandido et al. 2004b) and thus were counted. However, migrants arriving at the very far north and south of the lighthouse pose some difficulties in counting especially during hazy days and may have caused an underestimation of passage.

Weather data including wind speed, temperature, air pressure, and humidity were measured directly on an hourly basis at the beginning of each hour of observation using a handheld weather meter (Minox Windwatch Pro, Minox, Wetzlar, Hesse, Germany). Wind direction was determined using a compass. Visual estimation was made for cloud cover, visibility, and height of flight. Daily rainfall data was obtained from the Malaysian Meteorological Department. The height of flight was determined based on predetermined categories, i.e., ranging between ''0'' for flight that occurred below eye level to ''6'' for beyond the limit of binoculars (10× or less), but still detectable with binoculars or telescope of greater power.

To counter bias due to count effort, the counts were converted to passage rates; i.e., bird numbers per 100 hr of observation and truncated by date to include 80% of the season passage for each species. The magnitude of three major passages was presented as means and standard errors on an hourly and daily basis. Due to the small numbers of most migrants recorded at Tanjung Tuan, Pearson correlation analyses were performed between the number of the most abundant migrant (i.e., Oriental Honey-buzzards) and weather data to identify associations that explain variation in the migration pattern. A one-way ANOVA was performed to test the difference in the number of Oriental Honey-buzzards observed during different wind directions.

RESULTS

The numbers of migratory raptors recorded during the two nearly full-season counts at Tanjung Tuan were 37 615 birds (11 312 individuals/100 hr; Table 1) in 2009 and 72 277 birds (15 526 birds/100 hr) in 2010. Eleven species were recorded in 2009 and 10 species in 2010. The Oriental Honey-buzzard accounted for a substantial proportion of the total count for the two years, 85.9 ± 2.9% (mean ±SD; 30 000–60 000 individuals per season), followed by Black Baza (*Aviceda leuphotes*; 8.7 ± 3.8%), Chinese Goshawk (3.0 ± 2.0%), Japanese Sparrowhawk (*Accipiter gularis*; 0.7 ± 0.8%) and Grey-faced Buzzard (0.1 ± 0.1%). Other migrants appeared to be low in numbers, i.e., Peregrine Falcon (*Falco peregrinus*), Osprey (*Pandion haliaetus*), Booted Eagle (*Hieraaetus pennatus*), Black Kite (*Milvus migrans*), Eastern Marsh-Harrier (*Circus spilonotus*) and Pied Harrier (*Circus melanoleucos*).

Table 1. Raptor counts and passage rates by species at Tanjung Tuan, Peninsular Malaysia (2009–2010).

	Number of Individuals			Raptors/100 hr		
Species	2009	2010	Mean	2009	2010	Mean
Oriental Honey-buzzard (*Pernis ptilorhyncus*)	31 555	63 571	47 563	9 490.23	13 656.50	11 573.36
Black Baza (*Aviceda leuphotes*)	4282	4389	4336	1 287.82	942.86	1 115.34
Chinese Goshawk (*Accipiter soloensis*)	601	3175	1888	180.75	682.06	431.41
Japanese Sparrowhawk (*Accipiter gularis*)	445	82	264	133.83	17.62	75.73
Grey-faced Buzzard (*Butastur indicus*)	53	29	41	15.94	6.23	11.08
Peregrine Falcon (*Falco peregrinus*)	8	7	8	2.41	1.50	1.95
Osprey (*Pandion haliaetus*)	7	2	5	2.11	0.43	1.27
Booted Eagle (*Hieraaetus pennatus*)	1	2	2	0.30	0.43	0.37
Black Kite (*Milvus migrans*)	1	1	1	0.30	0.21	0.26
Common Buzzard (*Buteo buteo*)	1	0	<1	0.30	0.00	0.15
Eastern Marsh-Harrier (*Circus spilonotus*)	1	0	<1	0.30	0.00	0.15
Pied Harrier (*Circus melanoleucos*)	0	1	<1	0.00	0.21	0.11
Unidentified *Aquila*	1	0	<1	0.30	0.00	0.15
Unidentified falcon	1	0	<1	0.30	0.00	0.15
Unidentified *Accipiter*	625	989	807	187.97	212.46	200.21
Unidentified raptor	33	29	31	9.92	6.23	8.08
Total	**37 615**	**72 277**		**11 312.78**	**15 526.75**	

When data for all species were pooled, bulk (central 80%) passage dates covered a period of 29–38 d commencing on the last week of February with an average median passage date in the middle of March (Table 2). The bulk passage of Oriental Honey-buzzard occurred between 22 February (the earliest) and 1 April (the latest, i.e., ranging between 30–39 d with the median passage falling on 15 March and 14 March, respectively) for the two years. Similarly, the Grey-faced Buzzard arrived about the same period, although the passage period was shorter: 17–20 d. The bulk passage of Black Baza, Chinese Goshawk, and Japanese Sparrowhawk occurred in the middle of March and the passage periods of these birds took from 10 to 16 d.

For Oriental Honey-buzzard, daily migration started at 0900–1000 H and the migration activity increased considerably and reached a peak at 1200–1300 H before it gradually decreased and ended at 1700 H (Fig. 2). The birds often arrived low (about 30 m aboveground) in large flocks (328.7 ± 13.6 birds per flock). Both Black Baza and Chinese Goshawk tended to show a low activity during the early hours of the day and numbers peaked later at 1400–1600 H. For other raptors that passed through Tanjung Tuan, numbers were too low to indicate any obvious activity pattern across the day.

Results of Pearson correlation analysis indicated that the number of Oriental Honey-buzzards was unrelated to temperature recorded on an hourly basis ($r = 0.001$, $P = 0.997$). In contrast, the height of flight for the birds was positively correlated with the hourly temperature ($r = 0.241$, $P = 0.026$). The average daily temperature at the watchsite was 32.1 ± 0.1°C. The number of Oriental Honey-buzzards counted per hour showed a trend toward a negative relationship with wind speed, although the relationship was not statistically significant ($r = -0.101$, $P = 0.063$). On average, tailwinds from the southwest (3.36 km/hr ± 0.43) and west (4.60 km/hr ± 0.77) rose at 1200–1300 H, increased until 1400–1600 H, then decreased again at 1700 H (Fig. 3).

The highest counts for Oriental Honey-buzzards for both years were made during southwest and western winds (Fig. 4). However, the result of a one-way ANOVA indicated no significant difference in the numbers of Oriental Honey-buzzards counted during different wind directions recorded at the watchsite ($F_{7,281} = 1.835$, $P = 0.081$). Similarly, daily rainfall was unrelated to the numbers of Oriental Honey-buzzards observed ($r = -0.138$, $P = 0.188$).

Discussion

The first two years of a nearly full-season count of migratory raptors confirmed that Tanjung Tuan is

Table 2. Central 80% passage periods and median passage dates for migratory raptors counted at Tanjung Tuan, Peninsular Malaysia (2009–2010).

	80% PASSAGE DATES (NO. OF DAYS)		MEDIAN PASSAGE DATE[1]	
SPECIES	2009	2010	2009	2010
Oriental Honey-buzzard	22 February–1 April (39)	23 February–24 March (30)	15 March	14 March
Black Baza	16 March–27 March (12)	18 March–27 March (10)	20 March	22 March
Chinese Goshawk	29 March–8 April (11)	18 March–28 March (11)	30 March	19 March
Japanese Sparrowhawk	30 March–14 April (16)	21 March–3 April (14)	7 April	30 March
Grey-faced Buzzard	27 February–18 March (20)	2 March–18 March (17)	12 March	14 March
Peregrine Falcon	18 February–13 March (24)	23 February–2 April (39)	19 February	17 March
Osprey	13 March–29 March (17)	–	25 March	–
Unidentified *Accipiter*	27 March–11 April (16)	18 March–2 April (16)	5 April	18 March
Unidentified raptor	25 February–10 April (45)	27 February–25 March (27)	29 March	17 March
Grand total	**23 February–1 April (38)**	**24 February–24 March (29)**	**18 March**	**15 March**

[1] Median passage date representing 50% of annual count occurred for a given species with annual count of ≥5 birds.

an important migration location for these birds. Both complete as well as partial migrants from the northern hemisphere passing through Peninsular Malaysia were seen at Tanjung Tuan, with their numbers and arrival times varying by species. Except for the relatively lower number of species, the bulk passage (ranging from 37 615 or 11 312 birds/100 hr in 2009 to 72 277 or 15 526 birds/100 hr in 2010) was comparable to the count conducted in southern Thailand, which is geographically a bottleneck for migrants (DeCandido and Nualsri 2009). In terms of species, the major passages were made up of Oriental Honey-buzzards (30–39 passage days) followed by Black Bazas and Chinese Goshawks (10–12 d). The major species recorded at Tanjung Tuan were similar to those recorded in autumn (DeCandido et al. 2004a) and in spring in southern Thailand (DeCandido and Nualsri 2009), but with different proportions of species, indicating that different raptors are using different migration routes, which are not yet completely understood.

The daily arrival of migrants tended to differ according to species with the number of Oriental Honey-buzzards peaking around midday (1200–1300 H), followed by Black Bazas and Chinese Goshawks peaking later in the day. The Oriental Honey-buzzards were observed in flocks forming a steady stream from the direction of Sumatra. The general flight pattern of the birds was a combination of flapping and soaring over the sea (Yamaguchi et al. 2012), but the flight pattern was mainly soaring as soon as they reached land. The latter flight behavior was presumably associated with slope soaring as the birds used the horizontal winds that hit and deflected over the promontory. Occasionally, the birds were also observed ''kettling'' or circling using thermals over the sea.

At Tanjung Tuan, the arrival of Oriental Honey-buzzards at lower heights and earlier in the day than the other migrants may be explained by this species' ability to use both soaring and flapping flight ability, thus rendering them not directly dependent on thermals during migration; in this, they are similar to their western Asia counterpart, the Western Honey-buzzard (*Pernis apivorus*; Bildstein 2006). However, it should be noted that the height of the flight for the birds was positively correlated with hourly temperature, suggesting the use of thermals generated during the day that lifted the birds higher, possibly aiding them during migration when crossing the Straits of Malacca. A negative trend between the numbers of the birds counted per hour and wind speed may imply that strong winds may disturb the thermals needed for migration. Indeed, many birds were seen panting while crossing the water. There were also cases of birds crashing into trees to perch and rest immediately upon arrival at the lighthouse and, in some cases, falling into the sea. These observations suggested that birds do rely on thermals, at least to a certain extent, to lift them higher while minimizing the use of flapping flight to move across open water. In addition, the ability of Oriental Honey-buzzards to cross over the East China Sea (650 km) during their southbound migration was demonstrated to be weather-assisted (Yamaguchi et al. 2012).

On the other hand, the peak arrival of Black Bazas was after midday (1400–1500 H), with birds soaring fairly high and moving in large and tight flocks of

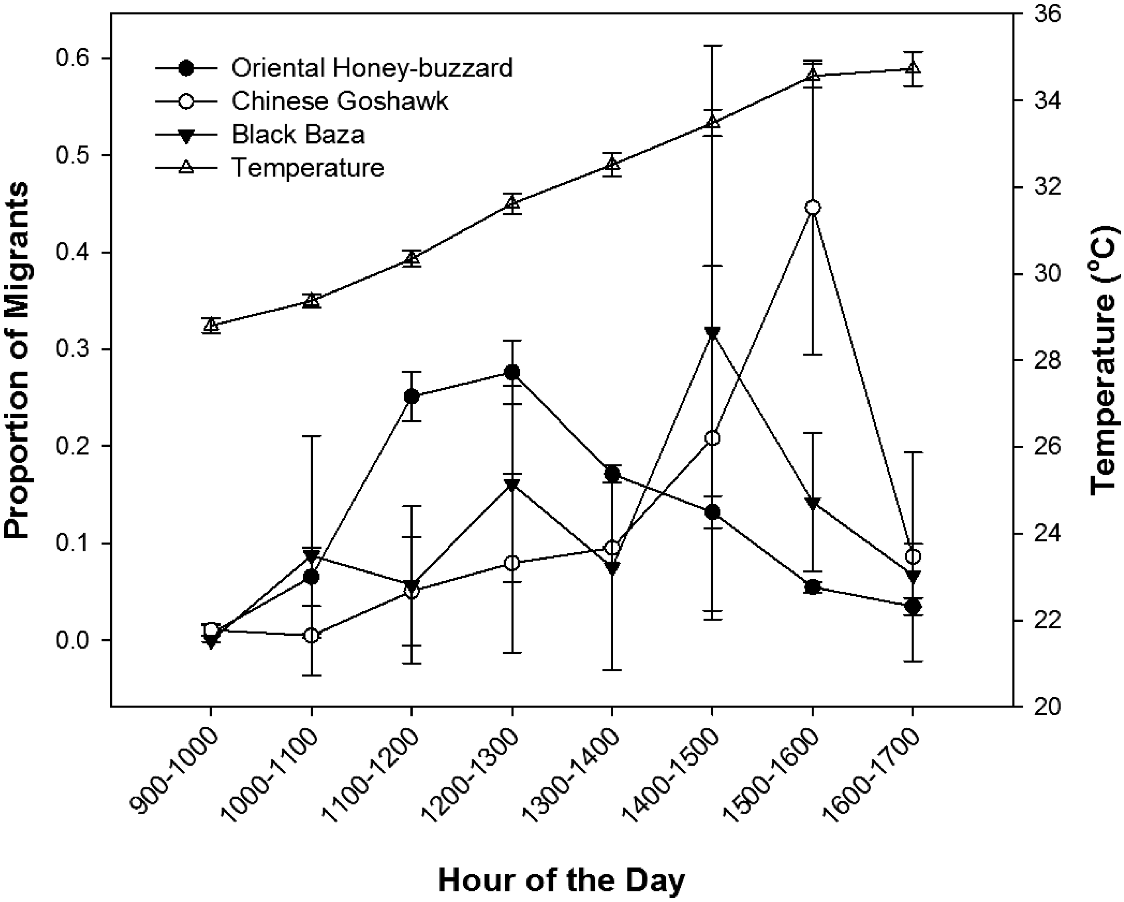

Figure 2. Daily temperature (°C) and activity patterns of three major migratory raptors (in their respective proportions and means ± SE) recorded at Tanjung Tuan, Peninsular Malaysia (2009–2010). The proportions of migrants were calculated based on the hourly number of birds recorded for a particular species relative to the total number of individuals recorded for that species during the entire migration count.

250 birds or more. The later arrival of Black Bazas, which have broad and rounded wings, may be associated with their soaring behavior that requires the updraft generated by thermals. Unlike Black Bazas, the Chinese Goshawks' flight pattern involved mainly flapping flight at a higher elevation. They often moved in large and loosely-formed flocks of about 200 individuals and occasionally in smaller groups or as single individuals. Individuals were seen flocking following the gradual buildup of thermals and soaring well away from the lighthouse. Chinese Goshawk arrival peaked at 1500–1600 H and this interval coincided with the highest temperatures of the day on average, suggesting that these accipiters use thermals during their passage. Similar flight behavior was seen in Japanese Sparrowhawk, which occurred in lower numbers and mostly consisted of single individuals. Described as one of the most oceanic of all long-distance migratory raptors (Bildstein 2006), Grey-faced Buzzards recorded at Tanjung Tuan were much less common than the three species mentioned above (i.e., less than 0.2% of the totals counted for the two years). The Grey-faced Buzzards that passed through Tanjung Tuan flapped their wings constantly and flocking was rare.

Based on observations made at Tanjung Tuan, the frequencies of southwestern and westerly winds were relatively high during and after midday (Fig. 3) and this coincided with the peaks of the three major spring migrants. However, we failed to detect any significant difference in the numbers of Oriental Honey-buzzards relative to different wind directions, possibly due to the small sample size.

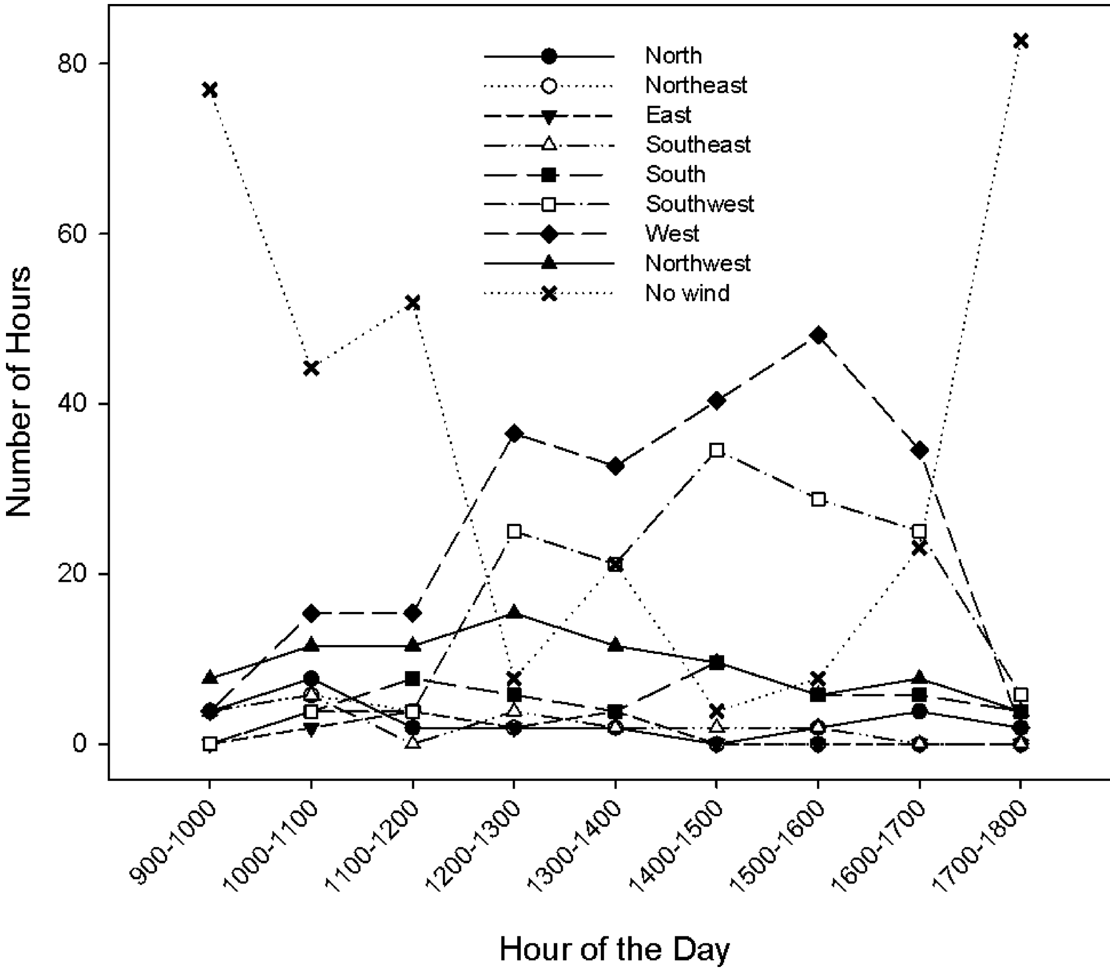

Figure 3. Number of hours during which different wind directions were encountered at Tanjung Tuan throughout the migration count.

Similar to the findings of DeCandido et al. (2006), we found the birds made landfall during light to moderate winds of less than 15 km/hr (Malaysian Nature Society unpubl. data). Nonetheless, at local scale, we believe that the combination of both thermals and tailwinds may facilitate movement across the Straits of Malacca.

Compared to their Nearctic and Palearctic counterparts, raptors of the East Asian–Australasian flyway are still poorly known (Kirby et al. 2008, DeCandido and Nualsri 2009), with only a few studies to date (Higuchi et al. 2005, Shiu et al. 2006, Yamaguchi et al. 2008, Germi et al. 2009, Yamaguchi et al. 2012). Surveys by raptor specialists have indicated that the current conservation status of as many as 17 (33% of the total of 51) migratory raptors in the region is considered unfavorable, and the status of many species remains uncertain (Goriup and Tucker 2007).

Fortunately, over the last decade, an increasing number of migration watchsites have been established in this region (such as Nijman 2001, Tordoff 2002, DeCandido et al. 2004a, Germi 2005, Germi et al. 2009, Sun et al. 2010) and migration counts were also made possible due to the joint efforts of birdwatchers and raptor biologists. We recommend the continuation of consistent monitoring of migratory raptors at Tanjung Tuan and the strengthening of collaborations with other raptor migration watchsites along the flyways through sharing of monitoring data. Continental analysis of migration data may help in the identification and protection of stopover and

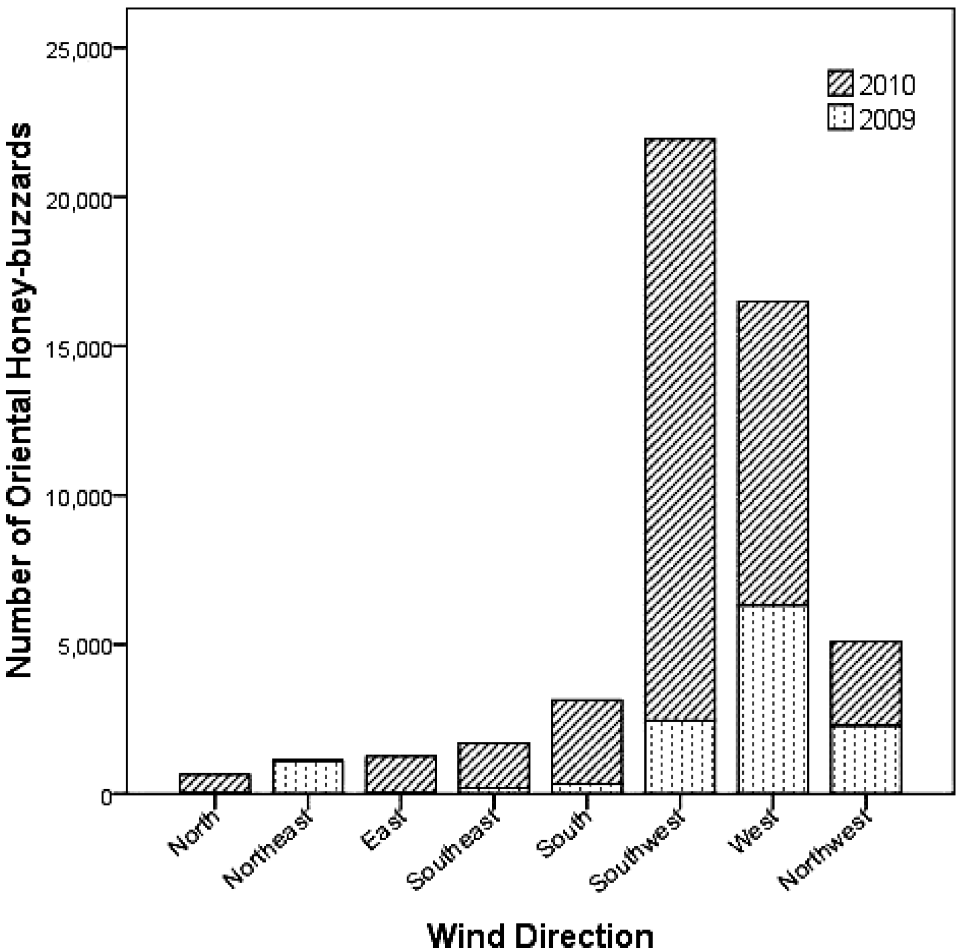

Figure 4. Number of Oriental Honey-buzzards counted during different wind directions, measured from the migration watchsite at Tanjung Tuan, Peninsular Malaysia (2009–2010).

wintering sites for these birds. Long-term monitoring of migratory raptors at different watchsites along the migration routes will aid in detecting the fluctuations in the raptor populations (e.g., based on Raptor Population Index; Farmer and Hussell 2008), if any, and the associated threats to these birds.

Compared with long-established migration watchsites, including Hawk Mountain Sanctuary in Pennsylvania, U.S.A., with migration counts that date back to 1934, Tanjung Tuan is in its infancy in such monitoring work. Nonetheless, it is worth highlighting that the Chumphon Raptor Centre located in southern Thailand, a bottleneck for raptor migration (DeCandido et al. 2004a), has been bestowed the title ''Hawk Mountain of Asia,'' marking the first step toward the conservation of Asian migratory raptors and their stopover as well as wintering sites. The establishment of the Chumphon Raptor Centre came about from local government support for a local raptor enthusiast's idea of building the center and serves as a good role model for other developing countries such as Malaysia in achieving conservation goals by educating the public about migration and the need for long-term migration monitoring work.

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