HAWK MIGRATION ASSOCIATION OF NORTH AMERICA

STANDARD DATA COLLECTION PROTOCOL FOR RAPTOR MIGRATION MONITORING

1. INTRODUCTION

1.1. Purpose and rationale of a monitoring program. The Hawk Migration Association of North America (HMANA) has promoted the use of a standard data collection protocol for raptor migration monitoring ever since its foundation in 1975. This protocol has been adjusted over time and a data collection form and a brief set of instructions have been made widely available to monitoring sites across North, Middle, and South America.

A monitoring program should provide three types of information: (1) An estimate/sample of population size, (2) An estimate of demographic parameters (e.g. information on population structure provided by data on species' sex and age classes), and (3) A measure of the environmental variables believed to affect the first two estimates (Hutchinson 1978, Ralph et al. 1993).

It is expected that this protocol and its revised contents continue to be clear, simple, and practical for citizen scientists and field biologists collecting data in the field, but also useful and informative for the needs of managers, conservationists, and scientists in later data analysis (Beissinger et al. 2006). This protocol can be easily customized for the particularities of a specific site.

1.2. Objectives of this protocol. The purpose of this document is to describe a standard data collection protocol for raptor migration counts. Although forms and sets of instructions for such protocol already exist, there is very little information on the rationale and background of such instructions (Fuller and Mosher 1987, Kerlinger 1989). This protocol has three specific objectives: (1) Provide standard instructions for raptor migration count data collection across sites, (2) Present the rationale of why these data should be collected and expand specific instructions for data collection procedures, (3) Introduce improvements to basic HMANA protocol that have been in use for many years. This protocol is not intended to replace former, but to stimulate raising the quality of data collection and to facilitate the access and use of information for analysis.

1.3. Organization of this protocol. The current set of HMANA (2006a) standards, termed "Protocol 1" in this document, have been in use since 1976 and revised in 1979 and 1986. This description follows the same format and structure: it starts with a description of the location and coverage where data are collected, the set of target species and population parameters that are recordable under field conditions for that particular site, and instructions for weather and flight recording conditions. This protocol encourages the use of metric system units at all times. Monitoring site specifics, species coverage, and data collection instructions should be carefully documented in a Seasonal Metadata Form (Appendix 2).

2. MONITORING SITE SPECIFICS

2.1. Location. This field includes a description of the localities' specifics, including coordinates in latitude/longitude format, elevation (in meters above the sea level [mASL]), and the choice between a Fixed versus a Mobile monitoring site.

A fixed location is the specific point from where migration counts are done throughout the season. Some sites, however, shift between two or more closely-located sites (e.g. <1-2 km apart) according to wind speed and direction, from where they can observe more migrants.

For monitoring purposes, counting more birds is not the goal but collecting systematic data from one site. No birds (e.g. many zeros) are as informative as many birds recorded. Sites that operate with professional field biologists and volunteers that acknowledge the higher value of data collected from fixed locations should avoid conducting counts from mobile sites. However, since many of these sites are run by citizen scientists whose goals are also recreational, it is very important that those mobile sites clearly label their counts as done from a mobile site and be able to differentiate between the locations used under the same general location name (e.g. Observation Site A, B, or C).

Some monitoring sites along diversion lines run counts from several sites at a time to cover the width of the flight's front. If these localities are fixed and operate in a coordinated fashion, they should be labeled as part of a Survey Line. Other specifics of a Survey Line such as distance between sites, the estimated number of birds that may be double counted (if any), and active communication system in operation should also be documented.

Photographs of the 360 degree view from each site on each year may be of use to document other reasons affecting count records, e.g. new human-made structures or growth of trees that block the field of view, whether counts are done from a tower or from the ground.

2.2. Seasons and dates of operation. A distinction between spring and fall migration season of operation, and the start and end date of field season. The seasonal timing of migrant raptor species have skewed distributions with long, heavy tails (a species comes by in low numbers for a long time, then increases in numbers, reaches a peak, and decreases to low numbers for a long time). Seasonal timing charts of target monitoring species should be used in the choice of seasonal coverage so dates of operation match the largest proportion (e.g. 95% of the migration period or migration window) in as many species as possible. Once dates of coverage have been chosen, the same sampling period should be used annually.

The length of the field season has a strong influence in its power to estimate trends. Lewis and Gould (2000) estimate that counts done over periods of 30 or 60 days have a lower statistical power than counts done over a period of 90 days. The ability of shorter field seasons to estimate population trends decreases because the coefficient of variation of annual counts increases in samples composed of fewer consecutive days of counts. Counts done over periods of >90 days can attain comparable statistical power than counts done over 90 consecutive days.

2.3. Daily times of operation. Start and end times of daily field work should also be planned based on a more detailed knowledge of the diurnal timing of migration at the site. Coastal sites, for example, have a tendency to have an earlier period of migration activity than inland sites (Kerlinger 1989) and appropriate coverage of the 95% window of daily migration should be planned to capture this particularity. The use of standard versus daylight savings times in data sheets and reports should be clearly noted.

Several monitoring sites do not operate on a daily basis. Some of them operate only on weekends and others only do so on days with "favorable" weather when observers believe more migrants can be recorded.

The optimal coverage of a field site is done through daily observations. Therefore the use of counts done over consecutive days is encouraged, since the monitoring usefulness of those data collected over non-consecutive days (e.g. weekend counts), or counts done over a structured sampling calendar (e.g. two days on, one day off), have not been tested.

Observers must clearly document the reason why a count has been interrupted or when a count day was missed, e.g. due to shortage of observers, or low number of birds recorded. The same judgment applies to sites that only operate on days with "unfavorable" weather conditions – the data generated on days with adverse data is as valuable as the one collected in days with good weather.

2.4. General description of the flight. Hawks constrain their migration to routes defined by favorable flight conditions. Site descriptions must select between (1) Diversion Line (a geographic or topographic feature that causes migrants to alter their course so as to avoid crossing the line, making them appear to follow it, e.g. a shoreline followed by hawks avoiding to cross over a large water body); and (2) Leading Line (a geographic or topographic feature that has properties that induce migrants to change their direction of travel so as to follow them, e.g. a mountain ridge with updrafts along its crest) (Mueller and Berger 1967).

3. SPECIES COVERAGE

3.1. Species covered. Each site must clearly define the species focus of their observations. The majority of monitoring sites include mostly raptors, but many of them also record vultures, and other non-raptor diurnal migrants. There are codes for species, sex, and age classes, color morphs, and subspecies in Table 1. Observers should be encouraged to be as accurate as possible with the identification of migrants but to also acknowledge that it is impossible to identify, sex, and age, every single migrant. The percentage of unidentified migrants from multiple sites ranges around 1-2%.

3.2. Migrants and non-migrants. When migrating, raptors commonly remain in stopover areas for several days and move back and forth past the observation point. In some localities, determining whether a species is migrating or not is difficult to discern. Each site must clearly determine what constitutes a migrant (e.g. "a hawk that flies past the observation point and does not come back") and observers must follow clearly written rules to make decisions regarding classifying an individual as a migrant or a "local" hawk.

4. DATA RECORDING AND DATA STORAGE

4.1. Equipment and materials in use. The evolution of optical equipment, field guides, and other field equipment has certainly changed the way migration counts are done in recent years and it has also improved the number of birds correctly detected, identified, and quantified. For this reason, there should be accurate notes on optic equipment in use, data recording equipment and hand instruments (includes instruments in use for collection of weather data and estimations of flight variables such as range-finders and ornithodolite-type equipment [Pennycuick 1982] and electronic weather station information).

Because fatigue influences the quality of data collected, observers should provided a list of personal care equipment and materials at the monitoring site, such as chairs, umbrellas, sunglasses, and other items that reduce fatigue. Other materials that seem of minor importance such as use of an owl decoy, availability of drinking water, and others should also be recorded.

4.2. Weather variables and flight recording conditions. Weather and flight-recording conditions are perhaps the most central variables required for data analysis. Variables recorded at monitoring sites include Wind Speed (Table 2), Precipitation (Table 3), Wind Direction, Cloud Cover, Humidity, Temperature, and Barometric Pressure (see details in Appendix 1 and Tables 2-4). Although Cloud Type recordings are not part of the standard protocol, cloud type may be of help in interpreting conditions of the boundary layer of the atmosphere in the absence of other data such as barometric pressure, humidity, wind, and precipitation.

(A note on cloud type here?/ a small table of cloud types?)

Some sites obtain data from airports and nearby weather stations, but careful records of the location of such sources of information should be noted. Although some variables may no vary greatly at a regional scale (e.g. barometric pressure and humidity) others such as wind speed and direction have a high variation within short distances. Notes on the type of instruments used in these records are important, e.g. humidity and barometric pressure are collected more accurately in weather stations and airports than with hand instruments.

Some localities do the recording of weather variables and flight recording conditions at the beginning of the hour or at half hour. Either choice should be clearly noted as well.

4.3. Identification, detection, and estimation. Sites should describe a scanning technique in use. Scanning should be actively done with naked eye and 8-10x binoculars, telescopes should not be used to find migrants, but only used for identification. Detectability varies in locations along diversion and leading lines and a detailed description of scanning technique per site is important.

Observers must record the identification aids available (books such as Dunne et al. 1988, Wheeler and Clark 2003, Liguori 2005). This version of the protocol for data collection introduces the use of sex and age classes, color morphs, and subspecies information whenever it is possible under field conditions. Although it is acknowledged that it is not possible to determine all the features requested for each record, this information, even if only determined in a low proportion of the records, may be of help in determining population parameters of importance for explaining population trends (e.g. the high proportion of juveniles versus adults in migration counts is an indicator of high recruitment in a given year).

A clear description of estimation methods is also important for locations and species that migrate in flocks using cross-country flights (sensu Pennycuick 1998). The dynamics of these flights involve migrants entering rising thermals from the bottom and gaining altitude as they circle around the center of the thermal to take advantage of the lifting warm air to gain height. Once the top of the thermal is reached, species exit the column in a gliding flight in their desired direction and start the process again when they have lost height.

It is not possible to conduct a good estimation of the number of hawks when they are circling and migrants should be counted when streaming between thermals through the use of hand (clicker) tally counters. Flocking hawks should be directly counted (1, 2, 3, 4…) when possible, or estimated (in groups of 3, 5, 10, 50…). Observers should be aware that the higher the multiple used in these estimates the higher the error estimating the right number of birds. Lower multiples should be chosen whenever possible.

4.4. Personnel and site/personnel coverage, visitors. The number and skill of observers in charge of counts also has a strong influence in the number of migrants recorded. The number of observers that actively participate in the count might be difficult to determine in some stations, since visitors play an active role in spotting birds that the main observer may have not recorded. It is recommended to keep separate track of the counts recorded by "official" and visitor observers. Clear documentation can help to adjust model estimates at the time of data analysis.

Disturbance at the site as a consequence of visitors should also be recorded using the following code: 0=none, 1=low, 2=moderate, and 3=high. These codes are subjective, but may be of help in later data interpretation. Many sites solve the problem of distracting interactions with visitors through the use of brochures and handouts with education and project/organizational outreach materials.

Sites should have a clear "job description" of count coordinator, main field biologist, and field assistant (paid, volunteer, etc.). A simple documentation of the qualifications of the team may be of importance when interpreting data.

Site operation instructions include the division of work at monitoring site and whether there is a clear training scheme for observers. Training is believed to help in reducing inter-observer variation in counts and result in an overall reduction of counts variability across years. Training workshops should include (1) Detailed descriptions of protocol in use, (2) Site-specific procedures, (3) Detection, identification, and estimation of migrants, and (4) Record-keeping and data case/management instructions. Coordination and work calendars should be attached to Seasonal Metadata Form.

4.5. Data collection and management. Data collected in the field should be transferred to a safe location at the end of the work day. Many localities collect field data in field notebooks and data is then transferred to data forms or electronic spreadsheets or databases. If followed appropriately, this procedure reduces the problem of a lost field notebook, since data is already safely stored. Data transfer should be done carefully and proof-read preferably by a different person than the one doing data entry.

Site coordinators must ensure data is safely stored, either in electronic data warehouses such as HawkCount.org (preferred) or in HMANA's paper archive (as a safe backup for electronically-submitted information). HawkCount.org has clear provisions for data use and intellectual proprietary rights and data storage safety procedures (HMANA 2006b).

Some ethical considerations to add in regards to data collection and management are related to the understanding of field crew that in migration counts (1) It is more important to collect data consistently than recording more birds per site, (2) It is better to err on the side of being conservative than inaccurate, (3) Identifications and estimations should also be conservative since a perfect record of identifications of species, sex and age classes, and other data per record is not possible under field conditions.

4.6. Seasonal metadata. Filling a Seasonal Metadata Form at the end of a field season is essential to determine when changes in the data collection protocol have occurred. Information in this form is very important in the later interpretation of data (Appendix 2).

SOURCES OF INFORMATION AND LITERATURE CITED

This protocol was generated from existing data collection protocols of HMANA, Hawk Mountain, HawkWatch International, Illinois Beach State Park, Holiday Beach Migration Observatory, Hawk Ridge, Pronatura Veracruz, Hawk Cliff, and Braddock Bay Bird Observatory. Jeff Smith, Laurie Goodrich, Steve Hoffman, and Sue Ricciardi provided comments on an earlier manuscript. Concepts of leading and diversion lines were obtained from an unpublished manuscript by Keith Bildstein and Chris Farmer.

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APPENDIX 1
WEATHER AND OBSERVATION CODES AND TABLES

Notes: The following tables (Appendix 1 and Tables 1-4) describe standards for data collection. Protocol 1 (HMANA 2006a) is the minimum, most basic one available, and grows in complexity with increasing level number, e.g. Protocol 3 is more specific than 1 and 2. One of the main changes in Protocol 1, which uses categorical data for different variables, are changes in the way data are recorded and replaces preset categories for longitudinal values. This protocol encourages the use of Metric System units. A site may use elements of different protocol levels, which should be documented by collecting seasonal metadata at the end of each field season (Appendix 2).

Variable	Protocol 1	Protocol 2	Protocol 3	Notes
Wind speed	Use category codes in Table 2	Data collected with standard hand instruments and recorded in precise units, not categories	Data collected with high precision instruments or electronic weather station	Data recorded at ground level unless otherwise noticed. Wind speed is recorded in km/h - kilometers per hour. To transform miles into km, multiply km x 1.609
Wind direction	Enter compass direction from which the wind is coming (16 possible categories) i.e. N, NNE, SE, etc. if variable, enter VAR. Data collected from site exposed to wind, with limited local interference	Use of a compass and wind vane to determine wind direction in degrees. Data collected from site exposed to wind, with limited local interference	Data collected with high precision instruments or electronic weather station	Use of a wind vane or marker to determine wind direction
Temperature	Temperature recorded with hand thermometer placed in shaded area of monitoring site	Temperature recorded with hand thermometer placed in shaded area of monitoring site	Data collected with high precision instruments or electronic weather station	Temperature is recorded in ºC degrees centigrades. To covert ºF to ºC, substract 32 to ºF and divide by 1.8
Humidity	Record the percent relative humidity with hydrometer	Record the percent relative humidity with hydrometer	Data collected with high precision instruments or electronic weather station	
Barometric pressure	Record barometric pressure with barometer in inches of Mercury (inHg)	Record barometric pressure with barometer in inches of Mercury (inHg)	Data collected with high precision instruments or electronic weather station	Metric system recordings in hPa or mbar (hectopascal, identical to millibar). To transform inHg to mbar, multiply inHg x 33.86
Cloud cover	Record percentage of sky with background cloud cover	Record percentage of sky with background cloud cover	Record percentage of sky with background cloud cover	
Cloud type	Not included	Four categories	??	
Visibility	Judge from your longest view and enter distance in km	Estimate clear visibility to the longest view to know landscape features with distances calculated from a topographic map	Estimate clear visibility to the longest view to know landscape features with distances calculated from a topographic map	To convert miles to km multiply miles x 1.1609

Variable	Protocol 1	Protocol 2	Protocol 3	Notes
Precipitation	Use category codes in Table 3	Use category codes in Table 3	Data collected with high precision instruments or electronic weather station. Detailed notes on distribution of precipitation per hour	To convert inches to mm, multiply in x 25.4
Flight direction	Enter compass direction migrants are heading (16 possible categories) S, SW, SSW, etc.	Enter compass direction migrants are heading (16 possible categories) S, SW, SSW, etc.	Enter compass direction migrants are heading in degrees	
Height of flight	Use category codes in Table 4	Use category codes in Table 4	Calculated with instruments such as radar, thermal imager, range finder, ornitholodolite, etc.	Standards in protocols 1 and 2 refer to the height of flight of "most" migrants for the hour. Standards in protocol 3 refer to data from individual birds and it is only expected from specific research projects
Observers	Number of trained observers contributing to the count for the hour noted	Coverage by standard number of trained official observers, either professional or volunteer	Coverage by standard number of official trained professional of volunteer observers	
Duration of observation	Specify time in minutes	Specify time in minutes	Specify time in minutes	

Table 1. Species names and sex, age, and color morph codes

Notes: Protocol 1 does not require identification of sex, age, and color morph classes. Identifiable sex and age classes fide Wheeler and Clark (2003) and other sources. The term Juvenile refers to birds in prebasic/preformative molts and Adult to birds in basic plumages (fide Howell et al. 2003, Pyle 2006). Two-letter species codes are those in use in Protocol 1 (HMANA 2006a).

The list is arranged in phylogenetic order according to AOU (1998) and subsequent supplements. New World Vultures (Black and Turkey Vultures) were placed within the Ciconiiformes in 1998 (AOU 1998), but still are considered in this table to allow consistence with earlier protocol.

* Denotes codes used in this document for the first time, not in the original source of Alpha Codes (Pyle and DeSante 2003).

** Denotes many species that have up to five 'juvenile' successive forms (prebasic/ preformative molt stages) that can be distinguished. The term "Basic" as used by Wheeler and Clark (2003) is used in this protocol as Prebasic/Preformative (Pyle 2006).

English name	Scientific Name	HMANA Code	Alpha Code	Protocols 2 and 3
Black Vulture	*Coragyps atratus*	BV	BLVU	
Turkey Vulture	*Cathartes aura*	TV	TUVU	U - unknown J - juvenile A - adult
Osprey	*Pandion haliaetus*	OS	OSPR	U - unknown J – juvenile A – adult
Swallow-tailed Kite	*Elanoides forficatus*	SK	STKI	U - unknown J – juvenile A - adult
White-tailed Kite	*Elanus leucurus*	WK	WTKI	U - unknown J – juvenile A - adult
Mississippi Kite	*Ictinia mississippiensis*	MK	MIKI	U - unknown J – juvenile A – adult Males and females can be distinguished in the field only under exceptional conditions
Plumbeous Kite	*Ictinia plumbea*	PK	PLKI	U - unknown J – juvenile A - adult
Hook-billed Kite	*Chondrohierax uncinatus*	HK	HBKI	U - unknown JL – juvenile light morph FL – adult female light morph ML – adult male JD – juvenile dark morph FD – adult female dark morph MD – adult male dark morph
Bald Eagle	*Haliaetus leucocephalus*	BE	BAEA	U - unknown J – juvenile PB I and II – "white-bellied" PB III – "Osprey-head" SA – subadult (either PB I, II, or III) A – adult**

English name	Scientific Name	HMANA Code	Alpha Code	Protocols 2 and 3
Northern Harrier	*Circus cyaneus*	NH	NOHA	U - unknown J – juvenile F – adult female Br – (brown) juvenile or female M – adult male
Sharp-shinned Hawk	*Accipiter striatus*	SS	SSHA	U - unknown J – juvenile A – adult
Cooper's Hawk	*Accipiter cooperii*	CH	COHA	U - unknown J – juvenile A – adult
Northern Goshawk	*Accipiter gentilis*	NG	NOGO	U - unknown J – juvenile A – adult
Gray Hawk	*Asturina nitida*	GH	GRHA	U - unknown J – juvenile A - adult
Common Black Hawk	*Buteogallus anthracinus*	CB	COBH	U - unknown J – juvenile A - adult
Harris's Hawk	*Parabuteo unicinctus*	HH	HASH	U - unknown J – juvenile A - adult
Red-shouldered Hawk	*Buteo lineatus*	RS	RSHA	U - unknown J – juvenile A - adult
Broad-winged Hawk	*Buteo platypterus*	BW	BWHA	U - unknown J – juvenile A – adult D – juvenile or adult dark morph
Short-tailed Hawk	*Buteo brachyurus*	ST	STHA	U - unknown JL – juvenile light morph AL – adult D – juvenile or adult dark morph
Swainson's Hawk	*Buteo swainsoni*	SW	SWHA	U - unknown J – juvenile A – adult JD –juvenile dark or intermediate/rusty morph AD – adult dark or intermediate/rusty morph ** Note that dark morphs may include rufous morphs and these two are lumped into a single category
White-tailed Hawk	*Buteo albicaudatus*	WT	WTHA	U - unknown J – juvenile A – adult**
Zone-tailed Hawk	*Buteo albonotatus*	ZT	ZTHA	U - unknown J – juvenile A – adult

English name	Scientific Name	HMANA Code	Alpha Code	Protocols 2 and 3
Red-tailed Hawk	*Buteo jamaicensis*	RT	RTHA	U - unknown J – juvenile A – adult JD –juvenile** intermediate/dark morph AD – adult** intermediate/dark morph ** Note that dark morphs may include rufous morphs and these two are lumped into a single category
Ferruginous Hawk	*Buteo regalis*	FH	FEHA	U – unknown JL – juvenile light morph AL – adult light morph JD – juvenile dark morph AD – adult dark morph
Rough-legged Hawk	*Buteo lagopus*	RL	RLHA	U – unknown JL – juvenile light morph AL – adult JD – juvenile dark morph AD – adult dark morph
Golden Eagle	*Aquila chrysaetos*	GE	GOEA	U – unknown J – juvenile S - subadult A – adult**
Crested Caracara	*Caracara cheriway*	CC	CRCA	U – unknown J – juvenile A – adult
American Kestrel	*Falco sparverius*	AK	AMKE	U – unknown F- female M – male
Merlin	*Falco columbarius*	ML	MERL	U – unknown BR – brown, female or juvenile M – male (subspecies: black [*F.c. suckleyi*], taiga [*F.c. columbarius*], and prairie [*F.c. richardsoni*])
Gyrfalcon	*Falco rusticolus*	GY	GYRF	U – unknown JW – juvenile white AW – adult white JG – juvenile gray AG – adult gray JD – juvenile dark morph AD – adult dark morph
Peregrine Falcon	*Falco peregrinus*	PG	PEFA	U – unknown J – juvenile A – adult
Prairie Falcon	*Falco mexicanus*	PR	PRFA	
Unidentified Vulture		UV	UNVU*	
Unidentified Accipiter		UA	UNAH	
Unidentified Small Accipiter	*Accipiter striatus* or *A. cooperii*	SA	UNSA*	
Unidentified Large Accipiter	*Accipiter cooperii* or *A. gentilis*	LA	UNLA*	

English name	Scientific Name	HMANA Code	Alpha Code	Protocols 2 and 3
Unidentified Buteo		UB	UNBH*	
Unidentified Eagle		UE	UNEA*	
Unidentified Falcon		UF	UNFA*	
Unidentified Raptor		UR	UNRA*	
Other Raptor		OO		

Table 2. Wind speed codes in Protocol 1

0 – less than 1 km/h (calm, smoke rises vertically)
1 – 1-5 km/h (smoke shift shows drift direction)
2 – 6-11 km/h (leaves rustle, wind felt on face)
3 – 12-19 km/h (leaves, small twigs in constant motion; light flag extended)
4 – 20-28 km/h (raises dust, leaves, loose paper; small branches in motion)
5 – 29-38 km/h
6 – 39-49 km/h (larger branches in motion; whistling heard in wires)
7 – 50-61 km/h (whole trees in motion; resistance felt walking against the wind)
8 – 62-74 km/h (twigs, small branches broken off trees, walking generally impeded)
9 – Greater than 75 km/h

Table 3. Precipitation codes in Protocol 1

0 – none
1 – Haze or fog
2 – Drizzle
3 – Rain
4 – Thunderstorm
5 – Snow
6 – Wind driven dust, sand, or snow

Table 4. Height of flight codes in Protocol 1

Notes: The estimation of height of flight is a function of the location of the monitoring site, in which case an accurate description of the monitoring site is important. For example, a site located in a mountain ridge may likely have birds above of below the horizontal. In this case, this protocol follows the recommendations of HawkWatch International's protocol – hawks below the horizontal will be added a positive or negative sign if above of below the horizontal, respectively. Negative values are naturally only limited to the lower categories of this scale. Height of flight categories apply to vertical height, which should be carefully recorded and not to be confused with side distance.

0 – Below eye level
1 – Eye level to about 30 meters
2 – Birds seen easily with unaided eye (eyeglasses not counted as aids)
3 – At limit of unaided vision
4 – Beyond limit of unaided vision but visible with binoculars – to 10x
5 – At limit of binoculars
6 – Beyond limit of binoculars 10x or less, but can detect with binoculars or telescope of greater power (mark "1" in comment box and note magnification)
7 – No predominant height

APPENDIX 2
SEASONAL METADATA FORM

Recorder name	
Position at monitoring site	
Mailing address	
Phone number	
E-mail	
Date filled	

Monitoring Site Specifics	
Location name	
County/Municipality	
State/Province	
Country	
Latitude	
Longitude	
Elevation	
Data source	Topographic maps Published literature Geographic Positioning System (GPS)
Type of location (fixed or mobile) if mobile, label each location separately (e.g. site A, B, or C) and provide latitude, longitude, and elevation for each site. Add additional sheets if necessary.	Fixed Mobile
Part of survey line?	Yes No
Photo documentation of 360 degree view of site?	
Tower, building, or vantage point used (attach photo)	Yes No
Seasonal coverage	Spring Fall
Periodicity of operation	Daily Regular not daily Weekend Irregular
Start and end dates of coverage	
Daily times of operation (start/end times)	
Type of migration	Divesion Line Leading Line
Species covered (See Table 1 for species codes)	BV TV OS SK WK MK PK HK BE NH SS CH NG GH

	CB HH RS BW ST SW WT ZT RT FH RL GE CC AK ML GY PG PR
Sex, age, color morph, and subspecies data available?	Yes No

Data Recording and Data Storage	
	Protocol in use at your site
Wind speed	1 2 3
Wind direction	1 2 3
Temperature	1 and 2 3
Humidity	1 and 2 3
Barometric pressure	1 and 2 3
Cloud cover	1, 2, and 3
Cloud type	??
Visibility	1 2 and 3
Precipitation	1 and 2 3
Flight direction	1 and 2 3
Height of flight	1 and 2 3
Observers	1 2 and 3
Duration of observation	1, 2, and 3
Binoculars (List brand name and power of each observer's binoculars, e.g. Zeiss Conquest 10x40, Leica Trinovid 10x40, etc.)	
Telescope(s) and eyepieces (ibid, e.g. Leica straight/angled 77 mm, 20-60 zoom eyepiece, etc.)	
Identification aids in use at monitoring site	Clark and Wheeler. Hawks of North America Wheeler and Clark. A photographic guide to North American

	raptors Dunne et al. Hawks in Flight Liguori. Hawks from Every Angle Sibley. The Sibley guide to the birds (or Eastern, Western version of it) Other: ____________
Tally counters?	
Hand weather recording equipment (list all, include brand name and model of each, e.g. Thermometer Forestry Supplies model B in degrees centigrades, Windmeter xxx, etc. Electronic hand weather meter (e.g. Kestrel xxx)	Electronic weather station Manual weather station Hand electronic Hand manual
Owl decoy?	Yes No
Other personal care equipment available on site	
Regular number of observers on site	1 2 3 4 Other: ___
"Average" experience of observers (add comments at the end of this form if necessary – list team's complete names and field seasons of experience of each observer)	1 field season of experience 2-5 field seasons of experience 6-10 field seasons of experience >11 field seasons of experience
Are there written "job descriptions" for members of the team?	Yes No
No. of professional (paid) observers in team	
No. of volunteer (unpaid) observers in team	
Disturbance on site	0 None 1 Low 2 Moderate 3 High
Is there a detailed training scheme for team members before the season start? (attach documents as necessary, e.g. training workshop contents)	Yes No
Data storage	HawkCount.org Other electronic databases Paper forms
Location of data storage	HawkCount.org HMANA's paper archive Other: ___________________ (give address where data is physically stored and name of data curator)
Comments and attachments	

Prepared by Ernesto Ruelas Inzunza. Version 11 April 2006