

**GPS Collar Performance  
Tellus 2D**



by

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Five Brown hyenas were fitted with GPS collars (Televilt, Sweden). Three GPS collars were retrieved for data download and two were equipped with remote data download option and will remain fitted to the hyenas for another two years. The programming schedule per collar varied (Table 1).

Table 1: Daily number of GPS fixes

Hyena ID	Daily No Fixes
VRBHb1m	17
VRBHb2m	20
KHb1m	144
GHb1m	24
DHb1m	24

Information recorded by the GPS collars included date, time, time to fix, latitude, longitude, dilution of precision, number of satellite vehicles and in case of retrieved collars temperature and altitude readings were additionally downloaded.

### **Collar Performance**

Collar performance was consistent during deployment, except for the GPS collar fitted to VRBHb1m. This hyena was severely injured during a fight and the collar was damaged (Figure 1) and therefore prematurely dropped off before its expiry date. However, on days when the collar functioned properly, performance was not different to the performance of all other collars. The percentage of recorded fixes differed per day and was dependent on the residual temperature between taken and missed fixes (Figure 2). High residual temperatures resulted in a lower percentage of fixes taken per day (Spearman Rank Correlation: VRBHb1m,  $r = 0.46$ ,  $p < 0.0001$ ; VRBHb2m,  $r = 0.83$ ,  $p < 0.001$ ; KHb1m,  $r = 0.89$ ,  $p < 0.0001$ ).

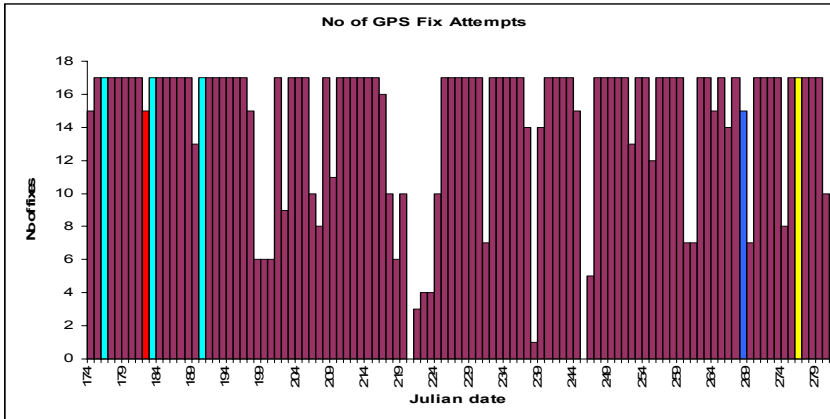
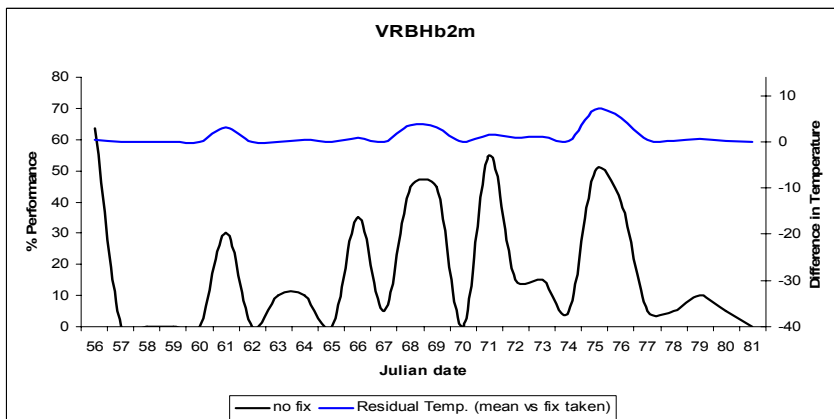
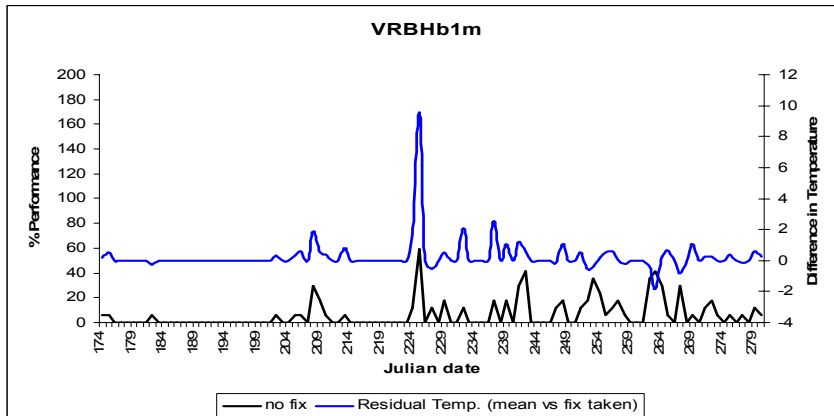


Figure 1: The following graph shows the number of fixes including attempts to record fixes according to the programmed schedule of VRBhb1m's collar (17 fixes per day). All bars should show 17 fixes, but as it can clearly be seen, the collar failed to take or attempt to take two positions on the 1 July (Julian date 182) and the performance decreased quite drastically afterwards (Red bar: collar failed for the first time (only 15 of 17 scheduled fixes attempted to be taken); turquoise bar: tracking flights with normal 40ppm VHF signal; blue bar: visual of brown hyena at colony and recovery signal (40 double ppm) was sent; yellow bar: last tracking flight to locate brown hyena with normal 40 ppm signal; 7 October 2005 (Julian date 274): drop off. Collar sent normal 40 ppm signal, changing to activity signal from time to time until drop off was triggered and the recovery signal was sent.



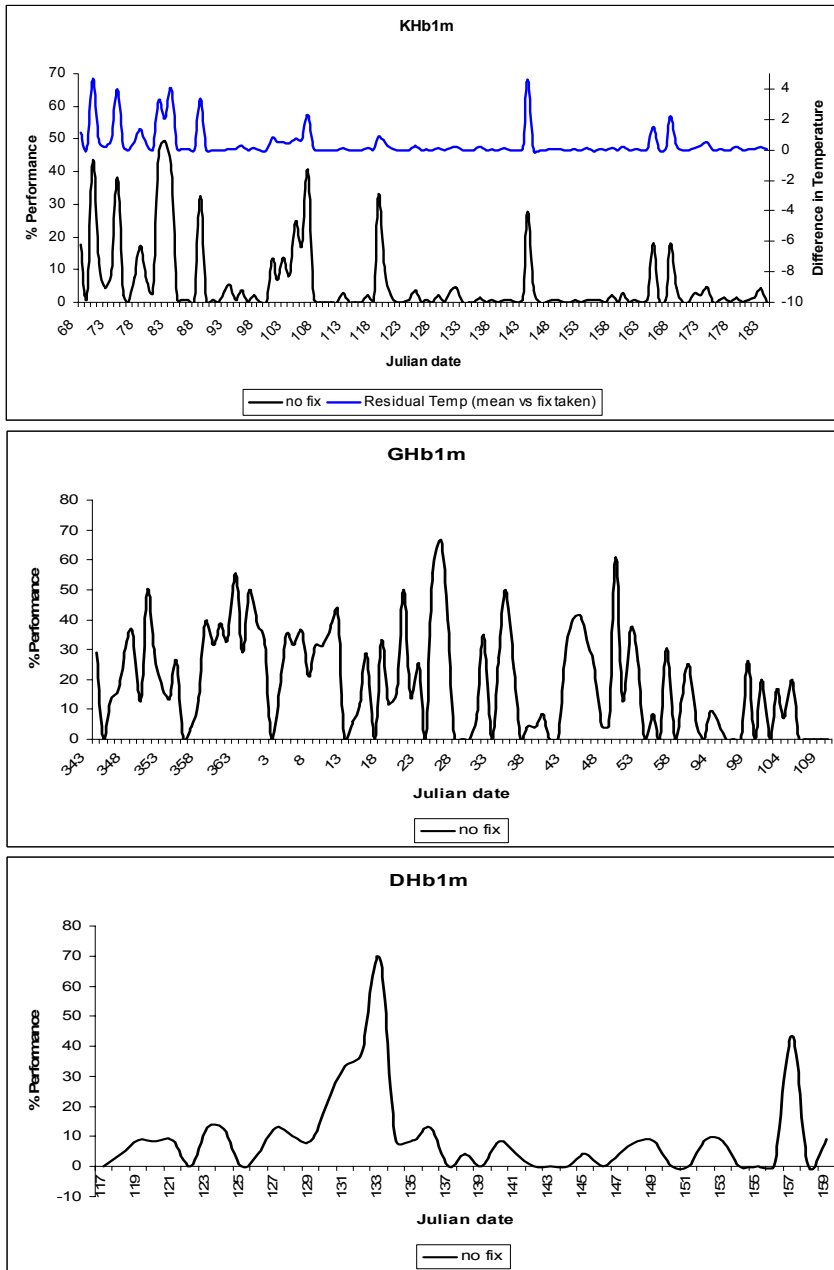


Figure 2: Percentage of daily fix collection and temperature residuals for three GPS collars.

*Efficiency of Fix Collection*

All collars were most efficient in fix collection at night (Figure 3). The difference between the proportion of fixes recorded during different times of the day was significant (ANOVA,  $p = 0.003$ ).

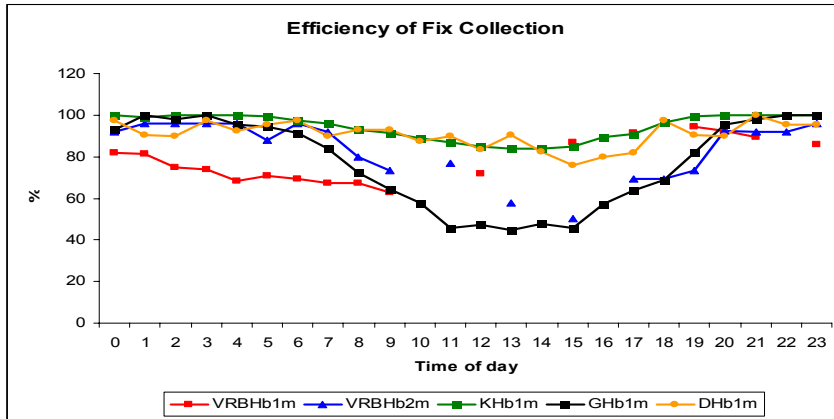


Figure 3: Percentage of fix collection during different times of the day.

### Accuracy of Fixes

All GPS collars recorded fixes using predominately four, five or six satellites (ANOVA,  $p < 0.001$ ) (Figure 4). Precision was poor with only three satellites, improving with four or five satellites and reaching an asymptote with six or more satellites (Figure 5).

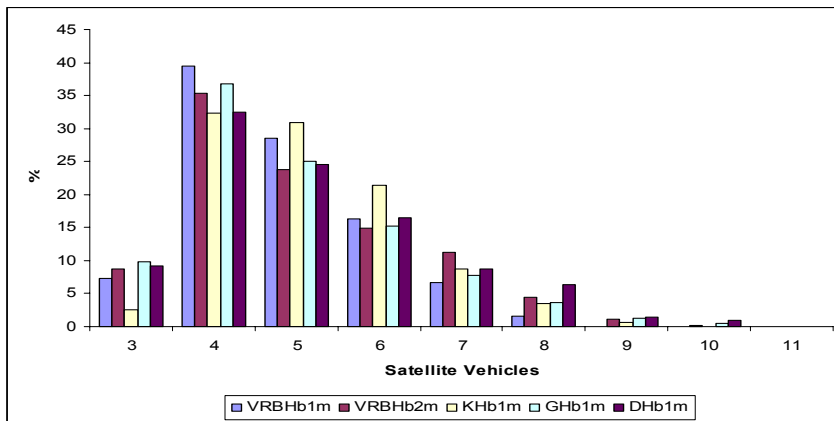


Figure 4: Percentage of the number of satellites used to record GPS position.

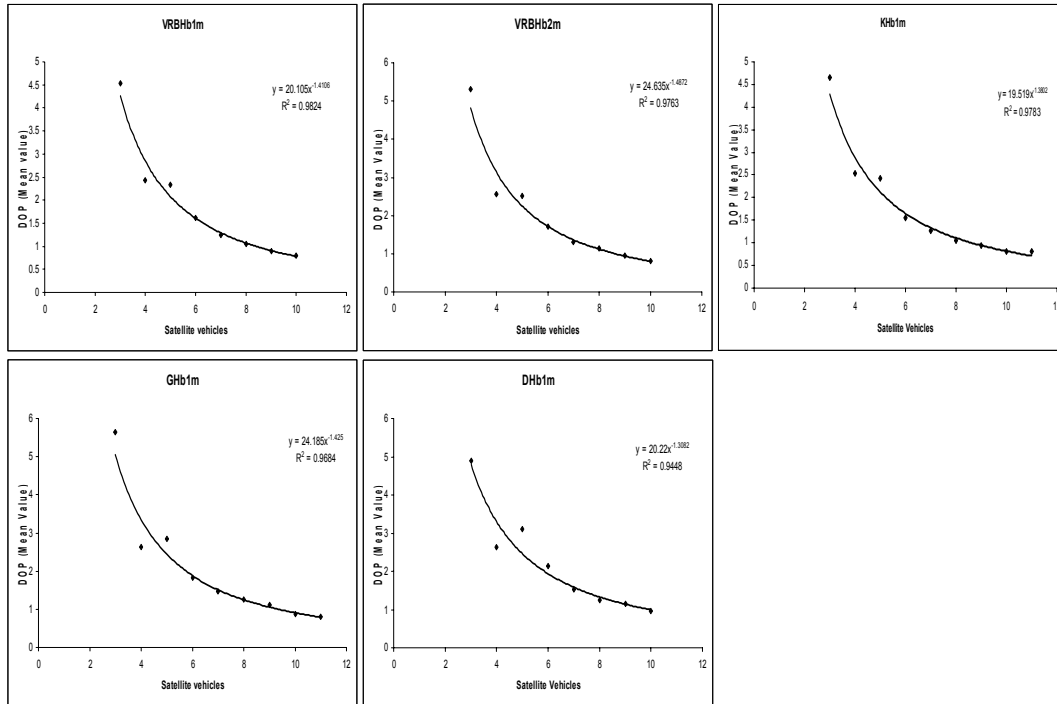


Figure 5: Dilution of precision (DOP) in relation to the number of satellite vehicles.

### Variation of Accuracy

The time it took to obtain a GPS reading depended on the number of satellite vehicles (Figure 6) but not on the time of the day (Figure 7). It took significantly longer to obtain a GPS reading with three satellites (ANOVA,  $p < 0.001$ ). Fix precision was dependent on the time of day (Figure 8) (ANOVA,  $p = 0.001$ ).

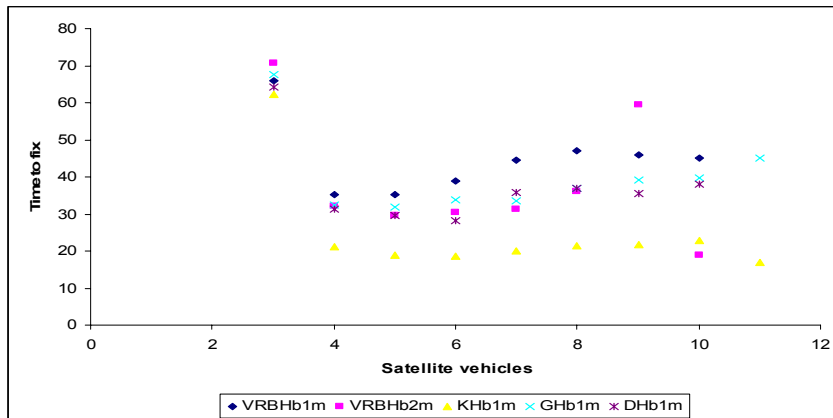


Figure 6: Time required to obtain GPS fix with differing numbers of satellite vehicles.

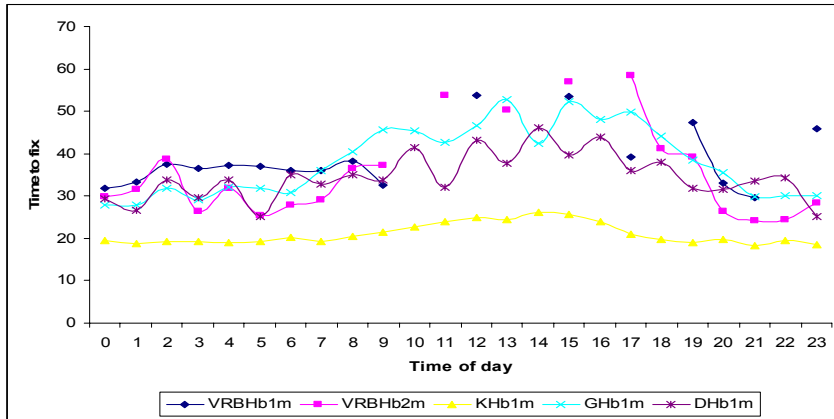


Figure 7: Time required to take GPS position during different times of the day.

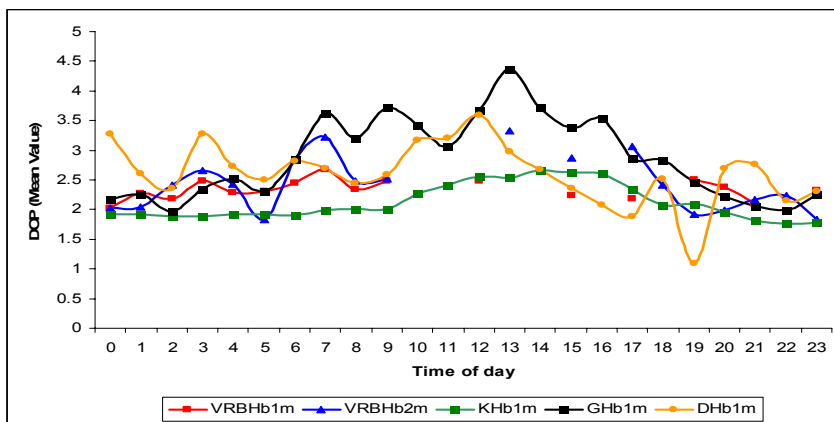


Figure 8: Dilution of precision during different times of the day.

The mean number of satellites per fix differed during different times of the day (ANOVA,  $p < 0.001$ ). More satellites per fix were found at night than during the day (Figure 9).

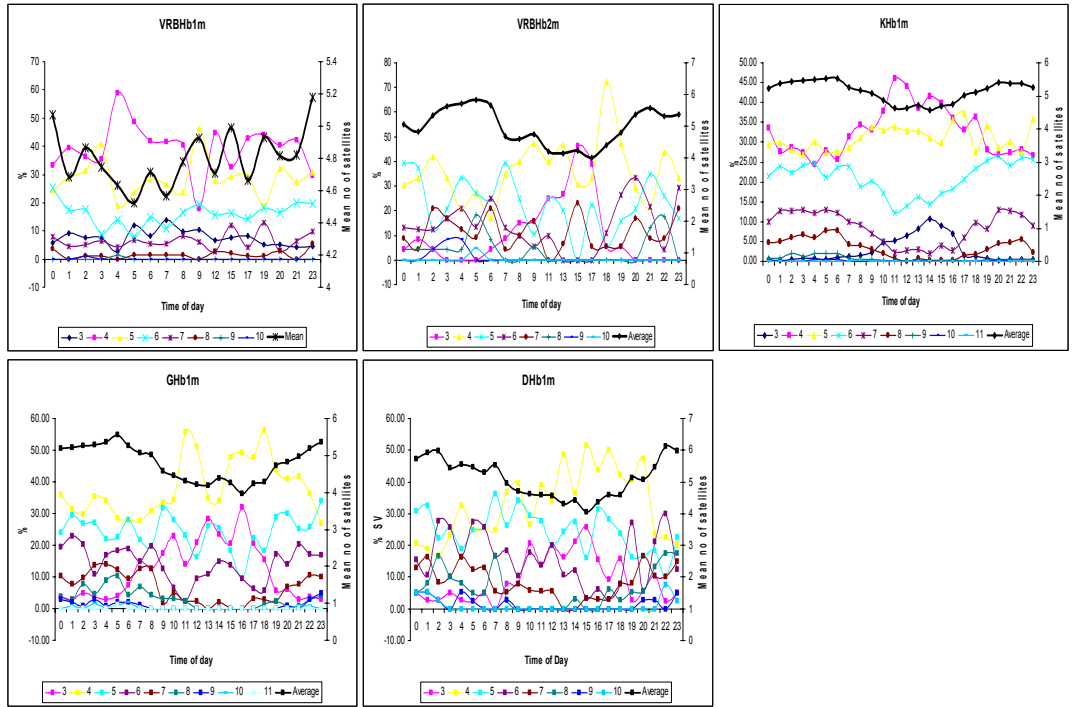


Figure 9: Mean number of satellites used to obtain GPS positions by different collars during different times of the day.