
FLIGHT TEST REPORT

TO: Quintin Kermeen, Telemetry Solutions; Brianna Doran, BLM- CPNM

FROM: Marc Horney, Associate Professor, Rangeland Resources
California Polytechnic State University, San Luis Obispo

SUBJECT: UAV Telemetry Retrieval Test at Carrizo Plain National Monument, May 3, 2018

DATE: June 22, 2018

CC: Aaron Drake, Brian Cypher, Tory Westall, Craig Fielher, Bob Stafford

Quintin and Brianna, what follows is a summary report of the telemetry data recovery test done at the Carrizo Plain National Monument on May 3, 2018. The objective of this field test was to determine the actual effective range of Telemetry Solutions 'long range' GPS receiver and sub-1GHz radio transceiver (GPSr/transceiver). A secondary objective was to try to recover telemetry data from San Joaquin kit foxes marked with collars which contained the same GPSr/transceiver, several of whose home ranges lay within 20km of the test area. These frequencies were provided by researchers from CSU Stanislaus.

Schedule of operations:

- The Cal Poly UAV flight operations crew arrived at aircraft launch location on Caliente Ridge road at approximately 1pm on 5/3/18 and proceeded to set up flight control station. (Yellow star on Fig 1)
- Three GPSr/transceivers were transported to pre-planned positions along Soda Lake road (10, 20, and 30km from launch location; Fig 1), set on fenceposts along the road or on the ground and activated between 2:15 and 2:45. Elevations of the GPSr/transceivers ranged from 610 to 884 m, (at 10 to 45 km distances). GPSr/transceivers and their locations were photographed and logged using the ArcGIS Collector app. The GPSr/transceivers were programmed to send long-range 'advertisement' signals every 10 seconds from noon to 4pm. After that, they reverted to their default setting of broadcasting signals once every 10 minutes.
- A base station/transceiver was activated and fitted into the custom-designed module built for it in the cargo bay of the RQ-20 aircraft (Fig. 8).
- The RQ-20 was launched at approximately 3:15pm and recovered at 3:30pm. During the flight it circled the launch location at a 0.402 km radius at an altitude of approximately 1,280 m above sea level. Launch site was at an altitude of 1,190 m.
- Upon landing the receiver module was removed and downloaded to a laptop. Position data from all three GPS units had been recovered. The time stamp indicated that data was being retrieved at the approximate time of the aircraft's landing and recovery.
- Having obtained GPS data from all three GPSr/transceivers that had been set, we erased the files that had been obtained from the first flight, then turned the base station/receiver off and relocated the three GPSr/transceivers from 10, 20, and 30 km to 35, 40, and 45 km. The RQ-20 was relaunched at 5:30pm for a single flight circuit (~5 min).
- The base station/receiver was downloaded at Cal Poly the following day; however no new files were obtained from the second flight.

Results:

The Telemetry Solutions GPSr/transceivers successfully delivered a signal out to 30km with a fresh battery and unobstructed line of sight to the receiver, which was carried by a fixed-wing UAV. On this system, the base station searches only for those GPS devices indicated by its white list. The white list is pre-set by the factory and can be modified by the user. The base station records the time of the initial download from each GPS device. A data file, with that time stamp, is created and saved in the base station. If additional data transmissions from that GPS device are received before the base station's memory is downloaded and erased, they are compiled into that original file. Without erasing the base station memory between downloads, it is not possible to determine what time any particular one of those data downloads from a given GPS device was retrieved. Because of this, we were unable to learn when data was first obtained from the three transmitters, and whether the aircraft's position in flight influenced the signal capture.

We did not retrieve any telemetry from marked kit foxes, although at least four home ranges of kit foxes marked with the same GPS/telemetry system were within 20-40km of the aircraft/receiver during the test (their collar transmitter frequencies were pre-loaded into the receiver's white list along with those of the test collars). The kit fox collars were set to broadcast their 'advertisement' signals at the default 10 min interval, so that only gave us - at most - two opportunities to detect a signal. Given the time of day of the flight, it is likely that the foxes were underground during the test, and the signal was attenuated by the soil overburden.

Our second flight failed to detect transmissions from 35-45 km, but our test did not entirely rule out that possibility. This was because this flight only lasted about 5 min, and after 4pm the GPSr/transceivers had reverted to their default once per 10-minute advertisement schedule. The flight operations crew were not aware of that fact.

These results suggest that measuring the amount of signal attenuation produced by soil at depths typical of SJ kit fox burrows could be an objective for study. If the signal is not always entirely quenched in these frequently dry soils, there might be circumstances where data might be recoverable at closer ranges during daytime surveys. We may also attempt to compare the relative ease and efficiency of obtaining telemetry data from this system from nighttime ground surveys (the usual method) versus nighttime aerial survey by UAV or simple use of topographic features (where available) which overlook the survey area within transmission range.

RQ-20 Launch Site and Telemetry Solutions GPSr/transceiver locations May 3, 2018

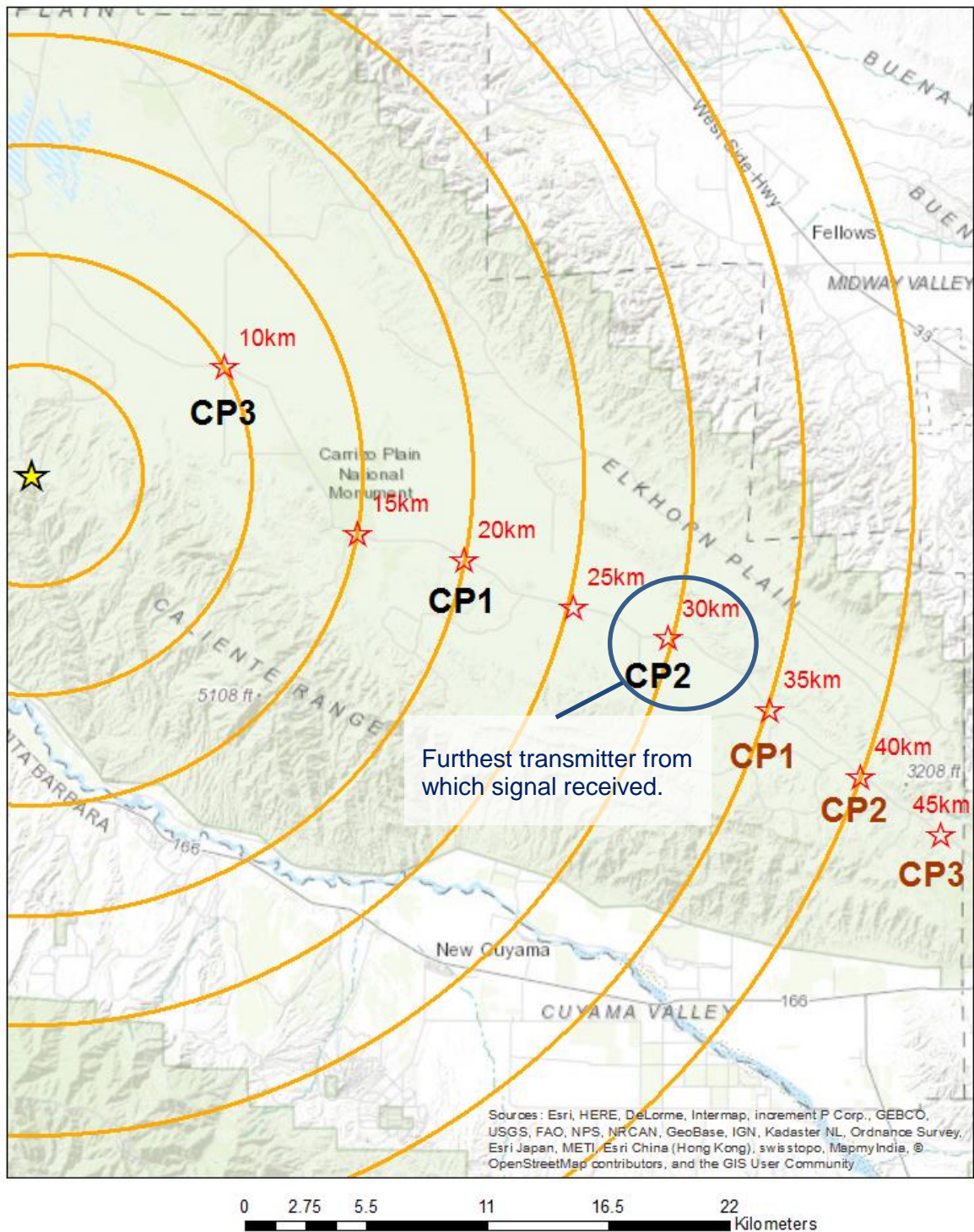


Figure 1. Map of UAV launch site (yellow star), and GPSr/transceiver locations. Transmitter IDs (CP1-3) in black font indicate locations for the first flight, and in brown text for the second flight.



Figure 1. 10km GPSr/transceiver location.



Figure 2. 20km GPSr/transceiver location.



Figure 3. 30km GPSr/transceiver location.



Figure 4. 35km GPSr/transceiver location.



Figure 5. 40km GPSr/transceiver location.



Figure 6. 45km GPSr/transceiver location.



Figure 8. Inserting base station/receiver payload module into RQ-20.



Figure 9. Caliente Ridge road UAV launch and flight control station site.



Figure 10. RQ-20 in flight.



Figure 11. RQ-20 recovery.