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Evaluation of wildlife impact on agricultural production through Remotely Piloted Aircraft Systems (RPAS): materials and methods and information obtained for the damage evaluation

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In the event of wildlife damage to agricultural crops, the regional law of Tuscany provides a compensation form based on the evaluation and the quantification of damage through inspections in the damaged areas carried out by experts. This method suffers from the difficulty of assessing from the ground the real extent of the damage with sufficient reliability for the cultural, environmental and orographic peculiarities that characterize the cultivation areas. The damage quantification for herbaceous crops, such as cereal crops, using aerial shots taken with Remotely Piloted Aircraft Systems (RPAS), overcomes maybe many of the limitations associated with the traditional survey from the ground. The images thus collected, processed with a specific photogrammetric software, provide objective data of high reliability and utility both for the management of compensation practices, that for the preparation of historical databases, essential for the correct management of wildlife. The study describes an example of damage quantification caused by wild boar (*Sus scrofa*) on a plot of 40.000 m² planted with Triticale (*× Triticosecale* Wittmack) through the evaluation and the processing of aerial images taken with an experimental aircraft multicopter: a quadcopter drone with autonomous flight and waypoints, designed and manufactured to specification, suitable for carrying a camera. In order to identify the areas affected by the damage and develop a specific flight plan, the photogrammetric shots were preceded by reconnaissance flights. The images were taken with a 20 megapixel camera from 80 m high; the speed of the drone was 4 m per second. The photogrammetric image processing returns both the three-dimensional model and the base map of the overflown area. The data obtained are metrically reliable and geo-referenced. On the data it is possible to operate interactively the measurement of areas and the distances. Special audits based on ground targets allow the comparison between direct linear measurements taken in the field and indirect measurements obtained by processing images from RPAS. The comparison showed that

these measures differ of about 0.1-0.2% for shots taken at 60 m above the ground. To the evaluation of an area of about 40.000 m², 30-40 minutes between flight and image processing are employed. Damage detection by RPAS and Photogrammetry shows several advantages: the mission and processing times for obtaining maps are reduced (a few tens of minutes), the results are contextual to the phase of the survey and allow immediate feedback and measurement of damage, the technician operates without physical access to the involved area, the relief mission is programmed and therefore repeatable, the data obtained is metrically and geographically reliable with very high precision. This involves the possibility of reaching equal compensation for the farmer and administrative protection. Finally, the measured data, stored in a historical database, represent an objective documentation, useful for the preparation of management detailed plans.