

## ABSTRAK

### KLASIFIKASI SPESIES LEBAH MADU TANPA SENGAT MENGUNAKAN MODEL *DEEP LEARNING INCEPTION-RESNETV2* DI LEMBAH SUHITA

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Lebah madu tanpa sengat (Meliponinae) berperan penting sebagai penyerbuk dalam menjaga keseimbangan ekosistem dan produktivitas pertanian, tetapi identifikasi spesies masih sulit dilakukan karena ukuran tubuh kecil dan kemiripan morfologi antarspesies. Penelitian ini bertujuan mengembangkan sistem klasifikasi spesies berbasis citra menggunakan arsitektur *deep learning Inception-ResNetV2*. Dataset terdiri atas 1.280 citra dari empat spesies lebah tanpa sengat, yaitu *Heterotrigona itama*, *Tetrigona apicalis*, *Tetrigona binghami*, dan *Tetrigona vidua*, yang diperoleh melalui pengambilan gambar langsung di Lembah Suhita. Model dikembangkan menggunakan pendekatan OSEMN dengan transfer learning melalui *feature extraction*, *fine tuning*, dan augmentasi citra. Model yang dihasilkan memperoleh akurasi sebesar 97,92% pada hasil pelatihan dan 92,5% pada pengujian. Model kemudian diimplementasikan dalam aplikasi berbasis web dengan mekanisme *energy based* untuk mengidentifikasi spesies sekaligus menolak citra yang tidak dikenali sistem. Pengujian implementasi model menunjukkan tingkat ketepatan hasil klasifikasi sebesar 70%.

**Kata kunci:** Lebah Madu Tanpa Sengat, Klasifikasi Citra, *Deep Learning*, *Inception-ResNetV2*, Transfer Learning

## ABSTRACT

### CLASSIFICATION OF STINGLESS BEE SPECIES USING THE *INCEPTION-RESNETV2 DEEP LEARNING* MODEL IN LEMBAH SUHITA

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Stingless bees (Meliponinae) play an important role as pollinators in maintaining ecosystem balance and agricultural productivity. However, species identification remains challenging due to their small body size and morphological similarities among species. This study aims to develop an image-based species classification system using the Inception-ResNetV2 deep learning architecture. The dataset consisted of 1,280 images from four stingless bee species, namely *Heterotrigona itama*, *Tetrigona apicalis*, *Tetrigona binghami*, and *Tetrigona vidua*, obtained through direct image acquisition at Lembah Suhita. The model was developed using the OSEMN approach with transfer learning through feature extraction, fine-tuning, and image augmentation. The resulting model achieved an accuracy of 97.92% during training and 92.5% during testing. The model was then implemented in a web-based application with an energy-based mechanism to identify species while rejecting images unrecognized by the system. The implementation testing showed a classification accuracy rate of 70%.

**Keywords:** *Stingless Bee, Image Classification, Deep Learning, Inception-ResNetV2, Transfer Learning*