

Capsid structure of a densovirus causing mass mortality in larval darkling beetles (*Zophobas morio*)

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Densoviruses (DVs) are small, ssDNA viruses of the family Parvoviridae that infect protostome and deuterostome invertebrates and are frequently highly pathogenic. To date there have been only five high-resolution capsid structures published for DVs. Here, we report the detection of a new DV, designated *Zophobas morio* black wasting virus (ZmBWV), causing a severe mass-mortality event in larval darkling beetles (*Zophobas morio*), reared worldwide for captive animal and even human nutritional purposes under the name "superworms". We resolved the high-resolution capsid structure of ZmBWV at 2.9 Å for genome-packaging, infectious particles and at the resolution of 3.3 Å in case of empty particles, both purified directly from the infected *Z. morio* larvae. By comparing the two structures, we characterize the conformational changes accompanying DV genome packaging for the first time, as well as the structural background of densoviral capsid-nucleic acid interactions. Furthermore, our results provide the first insights into the capsid morphology of a structurally previously-uncharacterized genus, Blattambidensovirus. We could conclude that despite of showing the typical structural features of a T=1 icosahedral particle of family Parvoviridae, the ZmBWV capsid harbors unique multimer interactions at its twofold, threefold and fivefold symmetry axes. The surface morphology of this new virus sheds new light into the evolutionarily-dynamic regions of the DV capsid.