TITLE: Crossing lines: Viruses encode ribosomal proteins

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Interactions between viruses and cells have played a major role in the evolution of life. In particular, viruses have a high impact on the composition of microbial communities due to their abundance and profound significance as agents of microbial mortality. Numerous studies have previous shown that viruses and their hosts are engaged in bilateral horizontal gene transfer which have significant consequences for the mode of virus-host interaction. Viruses infecting marine cyanobacteria present one of the most illustrious examples. These viruses are known to carry their own genes encoding some of the key components of photosynthesis. It has been also shown that these host-derived genes are translated and the produced proteins boost the energy metabolism in the infected cell, thereby increasing viral fitness. More recently, metagenomic studies have also contributed to expanding the repertoire of such metabolic host-derived genes found in viruses. Among the most unexpected discoveries was the presence of a high number of ribosomal proteins-encoding genes within bona fide viromes. Ribosomal proteins interact with the rRNA to form the ribosome, the molecular machinery for protein biosynthesis, and are the hallmark of cellular life forms. Here we explored the presence of ribosomal proteins within publicly available viral genomes. Fifteen viral genomes (14 bacteriophages and one eukaryotic virus) encoding ribosomal protein homologues were identified. This was surprising because even giant viruses of protists, such as mimiviruses and pandoraviruses, lack such genes in their genomes. Five different ribosomal proteins were found to be encoded by viruses, although the functional importance of these acquisitions is still speculative. Our results break the long-standing dogma that viruses do not encode ribosomal proteins and show that genes from virtually all functional categories are subject to horizontal transfer.