a)

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                                   1        10        20        30        40        50        60        70        80        90       100       110       117
1. CCPUN_00450                     EKSEHRALYLFLVGACH--D---KDGITVSVEEHSGSGRRPDIVINDHNH--KTVYIIEKK-------NGSA-----NEALQQIEDRNYDKKYHK--DYKRVINMGLNCIEDT--QT
2. CCPUN_08050                     EKSEHAATHLFLVGACH--N---IPTINVSSEKISGSGRSDIIVIDTKN--HIAYIIEKK-------SNSSSDVAVDEALNQIASRNYDKNQYK--SHKKEVHIGLNCIEDI--RK
3. CCPUN_00620                     EKSEHALLYSFLNGV-----FLGDENVEISAEMGSNIGQTDIVIKDKSN--HTIYIIEKK-------NKDA-----CMGLKQILNRDYYGQYIN--TYKKEVCIGLNIREND--NN
4. CCPUN_07590                     EKYEHGLFMFLNGV-----FLDNGNVEIAVETISNIGQMDIVIKDKSN--HTIYIIEKK-------NKDA-----CTGLKQILDRDYYGQYIN--EYNKEVCVGLNIREND--DN
5. CCPUN_06600                     EKSEHALLYSFLNGV-----FLGDENVEISAETISNIGQTDIVIKDKSN--HTIYIIEKK-------NKDA-----CTGLKQILDRDYYGQYIN--EYGKEVCIGLNIREND--DN
6. CCPUN_06660                     EKYEHALFSFLNGV-----FLGNENVEISAETISNIGQADIVIKDTSN--NTIYIIEKK-------NKDS-----YTGLKQIISRDYYGQYVS--EYNKEVCMGLNIIEND--DN
7. CCPUN_00770                     EKDEQNIIHAFLNGVCH--HTVG--GPRIRVEEHSGSGRSDITMDDIKN--NVVYIIEKK-------NQSA-----EVAIEQIEQKNYSGKYFR---KKKEVHIGLNCIENR--ED
8. CCPUN_02480                     EKDEQNIIHAFLNGVCH--HTVG--GPRIRVEEHSGSGRSDITMDDHKN--NVVYIIEKK-------NQSA-----EVAIEQIEHKNYSGKYFR---KKKEVHIGLNCIENR--ED
9. CCPUN_06260                     EKDEQNIIHAFLNGVCH--HTVG--GPRIRVEEHSGSGRSDITMDDIKN--NVVYIIEKK-------NQSA-----EMAIAQIEHKNYSGKYFR---KKKEVHIGLNCIENR--ED
10. CCPUN_02460                    EKDEQNIIHAFLNGVCH--HTVG--GPRIRVEEHSGSGRSDITMDDIKN--NVVYIIEKK-------NQSA-----EVAIEQIEQKNYSGKYFR---KKKEVHIGLNCIENR--ED
11. CCPUN_02830                    EKSEQHIIHSFLNGACH--HTVG--GPHMRVEEQTGCGRSDITIDDTKN--NVVYIIEKK-------NQSA-----EKALKQIEKNKYSNKYYR---KKKEVHIGLNCVFNK--DD
12. cBtQ1_00384                    EKQFHSNLHMLLQGL----GFLGGRKQMHSEALSSQGRADIVLELE----TVIYIIEIKY-------KSSG-----KIALEQIKANQYYSPYLL--RQKAIILLGLN--FNE--ST
13. CP022339_CDS4                  EKQYHSNLHMLLQGL----RFLGGRKMHMHSESASSQGRSDIVLELE----TAIYIIEIKY-------RSSG-----KMALEQIKANGYYKPYLL--RQKAIILLGIN--FNE--ET
14. CP022339_CDS5                  EKQYHSNLHMLLQGL----GFLGGRKMHMHSESVSSQGRSDIVLESE----TAIYIIEIKY-------RSSG-----KIALAQIKANGYYKPYLL--RQKSIILLGIN--FNE--ET
15. CP022339_CDS6                  EKQYHSNLHMLLQGL----GFLGGRKMHMHSESVSSQGRSDIVLELE----TAIYIIEIKY-------KSSG-----KMALQQIKSNSYYKPYLL--RQKAIILLGIN--FNE--ET
16. CP022339_CDS3                  EKQFHSNLHMLLQGL----GFLGGRKMQMYSESPSSQGRSDIVLELE----RVIYIIEIKY-------KSSG-----NIALAQIKANGYYKPYLL--RQKTIILLGIN--FNE--ET
17. cEper1_00601                   EKQYHSNLHMLLQGL----GFLGGRKMQMYSESASSQSRSDIVLELE----RVIYLIEIKY-------RSSG-----QIGLEQIKANGYYRPYLL--RQKTIILLGIN--FNE--ET
18. CCPUN_01160                    EAYYHTALHCLLEGA----------ELNPLSEHATSEGRIDIVINSLS---DVTYIIELKH-------DQNS-----NTALGQIEGNNYREKFLY--KDKNIVLIGLN--FSS--KM
19. CCPUN_03850                    EAYYHTALHCLLEGA----------ELNPLSEHATSEGRIDIVIDSLS---DVTYIIELKH-------DQNS-----NTALGQIEGNNYREKFLY--KDKNIVLIGLN--FSS--KI
20. CCPUN_08400                    EAYYHTALHCFLEGA----------ALNPLSEHATSGGRIDIVISLI---DVTYIIELKH-------DQSS-----NTALGQIEGNDYREKFLY--KDKNIVLIGLN--FSS--KI
21. CCPUN_01890                    EAYYHTALHCLLEGA----------ELNPLSEHATSGGRIDIVIDALN---DVTYIIELKH-------DQNV-----NIALGQIEGNNYREKFLY--KEKNIVLIGLN--YAS--KM
22. CCPUN_04230                    EAYYHTALHCLLEGA----------ELNPLSEHATRGGRIDIVIDSLS---DVTYIIELKH-------DQNA-----HTALCQIEGNEYIEKFLY--KGKNIVLIGLN--FSS--AM
23. CCPUN_02240                    EAYYHTALHCLLEGS----------ELNPLSEHITSGGRIDIVIDSLS---DVTYIIELKH-------DQSS-----NTALGQIEGNDYREKFLY--KEKNIVLIGLN--FSS--KL
24. CCPUN_06240                    EAFYHAVLHAFLRGA----------RMHPESEKCSNLGRIDIVINSIP---NLTYIIELKH-------GKNA-----DTALEQAQNAKYIQQYIR--QNKDIVIIGIN--FGS--DY
25. CCPUN_03870                    EAFYHSVLHAFLRGA----------KLNPESEKCSNLGRIDIVINSIP---SLTYIIELKH-------GQDA-----NTALKQITENTKYIQQYIR--QNKDIVVIGIN--FDS--ED
26. CCPUN_05850                    EAFYHSVFHAFLRGA----------KLNPESEKCSNLGRIDIVINSIP---NITYLIELKH-------GQDA-----HTAIEQITQNTKYIQQYVR--QNKDIVVIGIN--FDS--DK
27. CCPUN_07000                    EAFYHSVLHAFLRGA----------KLNPESEKCSNLGRIDIVINSIP---NITYLIELKH-------GQDA-----HTAIEQITQNTKYIQQYIR--QNKDIVVIGIN--FDS--DK
28. CCPUN_05940                    ESYYHTVLHTILECS----------YMEPKSEDSTNQGKIDIVLNSLP---HVTYIIELKH-------DSSA-----DVAMQQIDNKSYKDKFLT--KGKGIVTIGIN--FDSSKEK
29. CCPUN_07010                    EAYYHTVLHAILECS----------DMDPQNENTTNQGKIDIVLNSLP---YVTYIIELKH-------NASA-----DVAMQQIDNKSYKDKFLT--KGKGIVAIGIN--FDSAKAK
30. CP022339_CDS3                  ERSFQGALYSFLNSA-----FHTTYNTWASAEIDSGIGRIDIVMEDQYNDQSTVYIELKY-------DKPP-----SYALEQIHSKDYSIQYDL--CYKK-IVLIGLK--YDP--VK
31. CP022339_CDS2                  ERSFQRALYLFLNGV-----FHATHDMQTSAESDSGIGRIDIVMEDHRNDQRAVYIELKI-------DRPA-----LEALTQIHSKDYSIKYGS--CSEK-ILIGIT--CDA--AK
32. CP022339_CDS7                  ERSFQRALYLFLNGV-----FHATHDMQTSAESDSGIGRIDIVMEDHRNDQRAVYIELKI-------DRPA-----LEALTQIHSKDYSIKYGS--CSEK-ILIGIT--CDA--AK
33. CCPUN_02490                    ESFYHGFSLAMLASI--------SDRYHIRSNRESGLGRYDLLIIP--KNGHQALLLEFKYLHKEEKLENAA-----KLALQQIQSQAYHTELLQYPHVQEVVEAGIA--FSG--ES
34. CPEN_04810                     ESFYHGFVLAMLASI--------SDSYSIRSNRESGLGRYDVLIIP--KKDSKAILLEFKYLRKEEELENGA-----KVALQQIRGRAYHTELLQHTHVQEVIEIGIA--FSG--KA
35. CP022339_CDS11                 EGFYHGFVLGMLASL--------GITHYIRSNRESGLGRYDLLLIPK-KEGLKALLLEFKQVRKEEELESGA-----KLALNQIQTQAYHTEILQYSHVKEVVECGIS--FSG--KS
36. CP022339_CDS13                 EGFYHGFVLGMLASL--------GITHYIRSNRESGLGRYDLLLIPK-KESLKALLLEFKQIRKEEELESVA-----KLALQQIQAQAYHTEILQYPHVKEVVECGIA--FSG--KS
37. CP022339_CDS12                 EGFYHGLVLGMLASL--------GITHYIRSNRESGLGRYDLLLIPK-KEGSKALLLEFKQVRKEKELESAA-----KLSLQQIQTQSYHTEILQYPHVKEVVECGIA--FSG--KS
38. CP022339_CDS                   EGFYHGFVLAMLASL--------RITHYVKSNRESGLGRYDLLLIPK-KEGLKAILLEFKQVRKEEELESSA-----RLALQQIQTQAYHSELVQYPHVKEVVECGIA--FSG--KS
39. CP022339_CDS10                 EGFYHGFVLAMLASL--------RITHYVKSNRESGLGRYDLLLIPK-KEGLKAILLEFKQVRKEEELESSA-----RLALQQIQTQAYHSELVQYPHVKEVVECGIA--FSG--KS
40. CP022339_CDS9                  EGFYHGFVLAMLASL--------GRTHYVRSNRESGLGRYDVLIIP--KDGPKALLLEFKHVRKEEELETAA-----KLALSQIQDQAYHTELHYPHVQEVVEYGIA--FSG--KS
41. cPpe_00902                     ELFYSGFWLGLIAML--------TPDYIVESERETGSGRADILLLPQAGRSDNAIIIEYKVAKTLKDLPSVA-----EIGLQQIIDKKYDTKVKEHRYVKKLLKLSMA--FCG--KQ
42. cPpe_00379                     ELFYSGFWLGLIAML--------TPDYIVESERETGSGRADILLLPQAGRSDNAIIIEYKVAKTLKDLPSVA-----EIGLQQIIDKKYDTKVKEHRYVKKLLKLSMA--FCG--KQ
43. cPpe_00831                     ELFYSGFWLGMLHML--------ASEYTIESEIETGSGRADMLLIPQIGKQSNALIIEYKIAKDPINLDKMA-----QAGLAQIQDRQYASKIKRHLHVKKITKLAFA--FCG--KE
44. cPpe_00464                     ELFYSGFWLGMLHML--------CADYSIESERETGSGRADMLLIPQVGRNDNALIIEYKTTKTLENLDAVA-----QAGLAQIIAKQYHTKVKTYPHVRKITSRIALA--FYG--KK
45. cPpe_00080                     ELFYSGFWLGMLHML--------CADYSIESERETGSGRADMLLIPQVGRNDNALIIEYKTTKTLENLDAVA-----QAGLAQIISKQYHTKVKTYPHVRKITSRIALA--FCG--KE
46. cPpe_00452                     EKDYHNLIGGLLAPL--------SNRYHITSNQETGYGRCDHLLFPKVGYGDWAMVIEYKLAASSNDLAATA-----QAGLEQIITKKYDAHLTTYAHIKKISRIALA--FYG--KK
47. cPpe_00790                     EKDYHNLIGGLLAPL--------SNRYHITSNQETGYGRCDHLLFPKVGYGDWAMVIEYKLATSSNDLAATA-----QAGLEQIITKKYDAHLTTYAHIKKISCMALA--FYG--KE
48. cPpe_00644                     ERDYHNLIGGLLAPL--------INRYHIVSNQEAGYGRCDHLLIARAEYGDHAWIIEYKVAKDPKDLNAMA-----EEGLRQIKNKQYAAALKTHDHIKKITHWAMA--FCG--KK
49. Rilxscap_01929                 ELFYSGFWLGLINMLAP--DYI------IDSEKETGDGRADILLLPQAGRAENAIIIEYKVSKTIEELESTA-----KTGLEQIINDKRYDTKIKEQVHVKKIIKISM--AFCSKEVA
50. Ribuchn_01049                  ELFYSGFWLGLINMLAP--DYI------IDSEKETGDGRADILLLPQAGRAENAIIIEYKVSKTIEELESTA-----KTGLEQIINNKQYDAKIREQSHVQKIIKIAM--AFCSKEVA
51. Rilxscap_01957                 ELFYSGFWLGLVHTLAG--SYI------IESEKESGSGRADVILLPKVGKNDNAIIIEYKTAKTVEDLESIA-----KAGLTQIINNKQYDAKIREQSHVQKIIKIAM--AFYGKEVA
52. Ribuchn_00224                  ELFYSGFWLGLINTLAG--SYI------IESEKESGSGRADVILLPKVGKNDNAIIIEYKTAKTVEDLESIA-----KAGLTQIINNKQYDAKIREQSHVQKIIKIAM--AFYGKEVA
53. RiCNE_00470                    ELFYSGFWLGLINTLSP--GYV------IDSERETGSGRADILLLPKAGKQNNAIIIEYKICKSPDTLESIA-----KDGLDQIMRKKYETKIKEHSHVQKIIKIAM--AFCGKEVA
54. RiCNE_08010                    ELFYSGFWLGLINTLAS--DYI------IDSERETGSGRADIMLIPRAGKQDNAIIIEYKICKSPDTLESVA-----REGLEQIAKKRYDAKIKEYSHVQKIIKISM--AFCGKEVA
55. RiCNE_09450                    ELFYSGFWLGLINTLAS--DYI------IDSERETGSGRADIVLLPKIGKSDNAIIIEYKICKSPDILESVA-----KEGLDQIVRKKYEAKIKEHSHVQKIIKIAM--AFCGKEVA
56. RiCNE_11260                    ELFCSGFWLGLINTLAS--DYI------IDSERETGSGRADIMLIPRAGKQDNAIIIEYKICKSPEELESVA-----REGLEQIAKKRYEAKIKEYSHVQKIIKIAM--AFCGKEVA
57. RiCNE_11500                    ELFYSGFWLGLVNMLSS--SYI------ITSEQESGSGRADIIMIPKVGKEDNAIIIEYKIAKNIEDLASVA-----QIGLNQIIDKQYDVKVKEHKHVKKIIKLSM--AFCGKNME
58. RiCNE_02580                    ELFYSGFWLGFVNMLAP--NYI------ISSEQESGDGRADVVMIPKIGKGDKAMIIEYKIAKSSEDLADIA-----KSGLQQIIDKKYDTRIKEYQHVKQIIKITSM--AFCGKNME
59. RiargaT170B_01504              ERDYHNLMGGIFSPLSQ--QYI------IESNIESGYGRFDHLLIARKDIGDKAFIIEYKVSEKEEELVKLA-----QVGLQQIINNKAYDTRIRSHPHIKKIFKVSF--AFCSRKAE
60. REAB_A_bipunctata_01222        ERDYHNLMGGIFAPLSH--NYM------IESNLESGYGRFDHRLIARRDKGDKAFIIEYKVGKEEQELVKLA-----QAGLEQIINDKEYGTTIDNYPHIKNIFKIAI--AFCGKKSA
                                                                                  *                   * *
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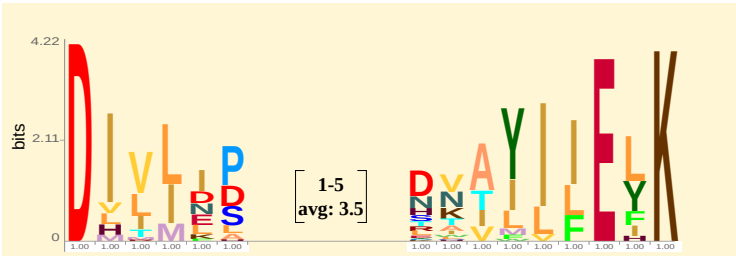
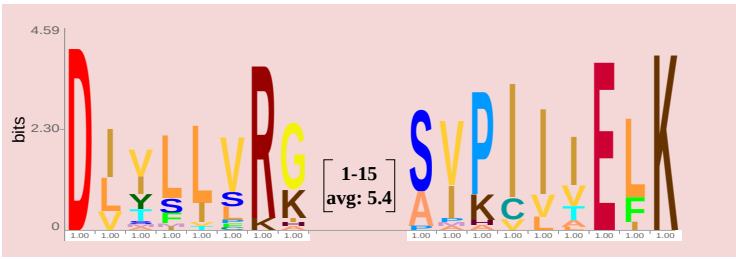
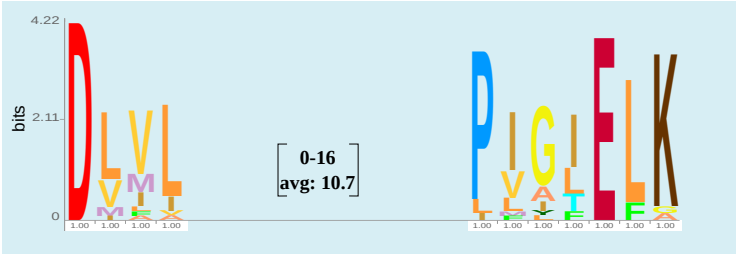
b)



The core PD-(D/E)XK nuclease domain in the DUF1703 protein family of *Cardinium* and *Rickettsia* depicted in (a) and discribed in Figure 4.



The conserved PD-(D/E)XK nuclease domain in type II-IV CI-like toxins of *Wolbachia* and related proteins.



The cryptic PD-(D/E)XK nuclease domain in type II-IV CI-like toxins of *Wolbachia* and related proteins.