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Supporting Online Material for

Mammalian Expression of Infrared Fluorescent Proteins Engineered from a Bacterial Phytochrome

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Supporting Online Material

Materials and Methods

Gene synthesis, mutagenesis and screening. A gene encoding IFP1.0 with codons optimized for *Escherichia coli* was synthesized by overlap extension PCR (*S1*). Genetic libraries were constructed by saturation and random mutagenesis as described (*S2*) and DNA shuffling (*S3*). IFP1.0 and mutants were cloned into a modified pBAD vector containing the heme oxygenase-1 gene from cyanobacteria. Libraries were expressed and screened as described (*S2*). A 676 nm laser was used for FACS screening of large libraries, with 710 – 900 nm emission filter.

Protein expression and characterization. IFPs in the modified pBAD vector were expressed in *E. coli* strain TOP10. Protein purification, fluorescence characterization and photobleaching experiments were done as described (*S2*). For quantum yield determinations, the integral of the emission spectrum (corrected for the wavelength-dependence of detection sensitivity) of a solution of IFP in PBS was compared with the analogous integral for an equally absorbing solution of Cy5 in PBS, whose quantum yield was assumed to be 0.27 (*S4*). For extinction coefficient determination, the holoprotein concentration was calculated based on the assumption that the extinction coefficient of holoprotein at 388 nm was equal to that of free BV, which was measured to be 39,900 M^{-1} cm^{-1} in PBS. This is based on the result that the absorbance by the Q band (670 – 700 nm) decreased by ~10-fold after denaturation while the absorbance at 388 nm did not change.

Chimera construction and imaging. DNA encoding IFP1.0 with codons optimized for mammals was synthesized by overlap extension PCR (*S1*). Other IFPs were created by QuickChange Multi site-directed mutagenesis. AKT1's PH domain was fused to the C terminus of IFP1.4 to generate chimeras IFP1.4-PH^{AKT1}. All the IFPs and chimera were cloned into pcDNA3.1 vector. HEK293A cells were transfected with IFP cDNAs using Fugene, then imaged 24-48 hr later on a Zeiss Axiovert microscope with redshifted Cy5.5 filter set (Chroma) and a cooled CCD camera (Photometrics, Tucson, AZ), controlled by MetaFluor 2.75 software (Universal Imaging, West Chester, PA).

Adenovirus construction. To create adenoviruses expressing IFP1.1 or mKate and GFP, a transcription unit comprising the IFP1.1 or mKate coding sequence, the poliovirus IRES, and GFP was constructed by assembly PCR, cloned into pENTR1a (Invitrogen), and transferred into pAd-CMV-DEST (Invitrogen) by Gateway recombinase (Invitrogen). Viruses were produced in HEK293 cells by transfection followed by one round of amplification, purified by anion exchange chromatography (FastTrap purification kit, Millipore), resuspended in HBSS + 10% glycerol, and stored in aliquots at -80ºC. Titers as assessed on HEK293 cells by GFP fluorescence were 5×10^{10} infectious units (IU) per mL for each virus.

Mouse imaging. The University of California San Diego Institutional Animal Care and Use Committee approved the protocol. Albino C57BL/6 mice (Jackson Labs) were injected with 2×10^9 infectious units of adenovirus via tail vein. After 5 days, belly fur was removed using a depilatory cream. Mice were imaged on a spectral imager (Maestro, Cambridge Research Instruments). The IFP channel was excited with a 650/50 nm (center wavelength/full width at half maximum) bandpass filter with a 700 nm long pass filter in series with the imager's tunable emission filter at 710/40 nm. The mKate channel was 590/24 nm bandpass for excitation and 620/20 in series with 630/40 nm for emission. Images for GFP were acquired with 467/45nm excitation and a 515 nm long pass filter in series with the imager's 530/40 nm for emission. Images were taken with 3 seconds exposure. Images for Fig. 3A were acquired before BV and 1 hr after injection of 250 nanomoles of BV, then scaled so that the brightest pixels after BV administration would display at maximum intensity. mKate and GFP images were first scaled with the same parameters as the IFP images, then the mKate images were further brightened 5-fold to make them visible. For fluorescence time course measurement, background-subtracted images of averaged liver intensity of the same region over liver at different time points after 250 nmol biliverdin injection was divided by the fluorescence intensity after 1 hour (Image J, NIH).

For spectral deconvolution, an image cube was collected on the Maestro with excitation at 620/20 nm and emission at 650-800 nm taking an image every 10 nm. Fluorescence region and autofluorescence regions were identified and spectrally unmixed using the instrument's software, revealing true fluorescent protein signal (displayed in red) and autofluorescence (displayed in grey).

For fluorescence molecular tomographic imaging (FMT), an Ad5I infected mouse was anesthetized with ketamine and midazolam, then injected IV with 250 nmol biliverdin in 10% DMSO. One hour later, the mouse was placed in a FMT 2500 imaging system (VisEn Medical, Bedford MA) and imaged in channel 1 with Prosense 680 settings. Images were reconstructed and windowed (106 – 167 nM apparent concentrations depicted in blue to red pseudocolors) to show the 3D distribution of fluorescence viewed from two different angles (Fig. S9).

After mice were killed, they were dissected and imaged using both IFP and mKate filter sets at 3 levels during dissection: with the skin on, with the skin removed, and then with the peritoneum and rib cage removed. Using Image J software, regions of 80x300 pixels were selected from below the liver up to the mid thorax. These regions were analyzed by plotting the profile. The values were normalized by dividing each pixel by the average of the last 30 vertical pixels over the thorax. These data represent contrast of liver to adjacent thoracic background.

Liver histology. Livers were frozen for cryohistology to compare fluorescence protein signal strength and relative expression. Sections were cut at 10 μm and then imaged on a fluorescence stereomicroscope (Lumar, Zeiss). Filter sets used were ex 470/40 nm and em 525/50 nm for GFP, ex 560/25 nm and em 607/36 for mKate, and ex 665/45 and em 725/50 for IFP. Images were acquired at 15s exposures for IFP and mKate channels and 3s exposure for the GFP channel, then displayed with intensity enhancements of 2, 1, and 1, respectively. Therefore the relative gains for the IFP, mKate, and GFP channels were 10, 5, and 1, respectively.

SOM Text

Evolution of IFP1.4. Random mutagenesis of IFP1.1 with fluorescence activated cell sorting using a 676 nm laser resulted in IFP1.2 with 32% increase in quantum yield (QY), due to an additional M54V mutation. However, the parent of IFP1.2, *Dr*CBD, was previously shown to be a dimer. Multiple angle light scattering at 785 nm (Dawn 8+, Wyatt Technology, Santa Barbara CA) of IFP1.2 gave an apparent molecular weight 80 kDa, about twice the predicted monomeric size of 36.5 kDa, suggesting that IFP1.2 was also a dimer. To monomerize IFP1.2, Leu311 was rationally mutated to a lysine since it is in the hydrophobic dimer interface based on the crystal structure of *Dr*CBD (Fig. S3). Size exclusion chromatography (SEC) showed that the resulted mutant (named as IFP1.3) was eluted later than IFP1.2 (Fig. S3B), suggesting that IFP1.3 is possibly a monomer. SEC of IFP1.2/IFP1.3 mixture confirmed the result (Fig. S3B). However, the QY of IFP1.3 was slightly decreased (8%). Another round of random mutagenesis and screening generated IFP1.4 with increased brightness. SEC (Fig. S2) and multiple angle light scattering at 12 μM concentration (apparent molecular weight 41.5 kDa ± 10%) confirmed that IFP1.4 is monomeric. A sequence alignment of IFP1.4 with *Dr*CBD is shown below with internal mutations shaded in blue. The S2A mutation (shaded in red) is to optimize the Kozak sequence when expressed in mammalian cells, and the C-terminal hexahistidine motif is to enable immobilized metal ion affinity chromatography.

```
DrCBD           MSRDPLPFFPPLYLGGPEITTENCEREPIHIPGSIQPHGALLTADGHSGEVLQMSLNAAT 60
IFP1.4          MARDPLPFFPPLYLGGPEITTENCEREPIHIPGSIQPHGALLTADGHSGEVLQVSLNAAT 60

DrCBD           FLGQEPTVLRGQTLAALLPEQWPALQAALPPGCPDALQYRATLDWPAAGHLSLTVHRVGE 120
IFP1.4          FLGQEPTVLRGQTLAALLPEQWPALQAALPPGCPDALQYRATLDWPAAGHLSLTVHRVAE 120

DrCBD           LLILEFEPTEAWDSTGPHALRNAMFALESAPNLRALAEVATQTVRELTGFDRVMLYKFAP 180
IFP1.4          LLILEFEPTEAWDSIGPHALRNAMFALESAPNLRALAEVATQTVRELTGFDRVMLYKFAP 180

DrCBD           DATGEVIAEARREGLHAFLGHRFPASDIPAQARALYTRHLLRLTADTRAAAVPLDPVLNP 240
IFP1.4          DATGEMIAEARREGMQAFLGHRFPASHTPAQARALYTRHLLRLTADTRAAAVPLDPVLNP 240

DrCBD           QTNAPTPLGGAVLRATSPMHMQYLRNMGVGSSLSVSVVVGGQLWGLIACHHQTPYVLPPD 300
IFP1.4          QTNAPTPLGGAVLRATSPMHMQYLRNMGVGSSLSVSVVVGGQLWGLIVCHHQTPYVLPPD 300

DrCBD           LRTTLEYLGRLLSLQVQVKEA         321
IFP1.4          LRTTLEELGRKLSGQVQRKEAEFHHHHHH 329
```

Increase of cellular IFP fluorescence by exogenous BV. HEK293A cells were transiently transfected with IFP1.4 in one 10-cm dish and incubated for 24 hours, trypsinized and replated into 5 wells of 6-well plate with ~ 400,000 cells per well. After another 24 hours incubation, different amounts of BV (final concentrations 5, 10, 20, 40 μM) were added, followed by 90 minutes incubation. Then cells were trypsinized and washed with PBS and resuspended for fluorescence measurement by a 96-well plate reader with monochromators (Safire, TECAN). Untransfected HEK293A cells with additions of exogenous BV were used as controls. Infrared fluorescence of transfected HEK293A cells increased upon the increase of added exogenous BV concentration and was saturated at 20 μM, while the untransfected cells did not show infrared fluorescence either with or without BV (Fig. S6A). Addition of exogenous BV rapidly (within 10 minutes) led to infrared fluorescence of matured P2 cortical neurons, two weeks after transfection of IFP1.1 (Fig. S6B), which were practically nonfluorescent before addition of BV.

Half-life of IFP1.4. Cycloheximide (30 μg/ml final concentration) was added to HEK293A cells 24 hours after transfection of IFP1.4. Infrared fluorescence was fitted with single exponential decay assuming first-order decay kinetics of protein degradation (*S5*) (Figs. S7 and S8). The half-life of IFP1.4 in HEK293A cells with or without exogenous BV was calculated to be 4.44 and 3.61 hours, whose average is 4.03 ± 0.41 hours.

Multiple sequence alignment. Below, 130 bacteriophytochrome-like sequences from NCBI database are aligned using *Dr*CBD as the query (*S6*). It is suggested that readers zoom in to read the alignment.

```
Query         1    MSRDplpffpplylggpEITTENCEREPIHIPGSIQPHGALLTADGHSGEVLQMSLNAAT  60
NP_285374     1    ............................................................  60
YP_488045     30   .D.............V.IALAEPDLRPVSV.A.IEA  66
YP_569534     29   .D.............M.IALAEPELRPVSV.A.IQA  65
YP_533633     28   .D........K....M..AFVEPELRPVSV.V.VEA  64
NP_442237     20   ..TAHL.....LVVVLQEPDLTIS.I.A.CTG  51
ZP_01628825   12   .DISR.NK............V.FALKEPDLTI..V.D.IFN  53
NP_486939     11   QVDLS..SK.......L.....V..VLQEVDLTI..V.N.TFN  53
YP_321522     12   VDLS..NK.......L.....V..ALQEIDLTI..V.N.TFN  53
YP_488044     7    DVDLT..D..............-..I.FNDDLRAVAV.S.I..  48
ZP_01459223   7    .LDLSQ.D.....LL.G..S..V..AFR.PDRLLEVV.A..QA  49
NP_948356     28   .D........A.....Y.FVVSETDLRIASV.A.VED  64
YP_569533     7    DVDLT..D........C.....-..I.FNDELK.VAV.S.IGN  48
YP_779569     10   .ADLTD.D........A.....-..I.FTDDLDTVAA.A.LPD  51
ZP_01623500   17   DQ...Q.S.QV....I..VLEEP.LKI..V.K.TQS  52
YP_324352     10   .NVTSLKEA...LS.Q.....V..VLEEPDLKI..V.N.TWS  51
NP_948355     15   .DD.......A.....L..ALAADM-TIVAG.D.LPE  50
NP_487197     10   .NVTSLKEA...LS.Q.....V..VLEEPGLKI..V.N.TWG  51
YP_779570     28   .DK.............YVFVLLERELRIVSV.A.VEK  64
ZP_01630443   10   .NVNSLKEA...LFKH.....V..VLEEPDLKI..I.N.TWS  51
YP_001894923  15   D.A....Q...G.....F.FSISA-T.TL..V.A.T..  51
YP_001863766  19   ....SSQ.....V..VLEEPELKI..V.T.TLK  51
YP_001174646  14   DR.AD............F..VVSEPDLRIQ.A.E.VRD  52
ZP_01461267   12   .VDLT..D........A.....V..VLSEPGLVLTHA.E..PA  54
ZP_01730981   10   D.NLQRL.ELQ..LW.KT....V.FVL.ESNLKIV.T.S.TKQ  52
NP_354963     9    DS.GA.......A..E.....VLSAREFS.V.A.D.L.N  47
YP_608942     13   .R.AQ...QV........F..VL.NT.LRI..A.E.TER  51
YP_001668195  12   .R.AQ....L.S......F..VL.ATDLR...A.E.VEH  50
YP_001769101  16   .D......L.T.....F..AVQ.PDLRIV.I.D.VPD  52
YP_001748669  19   .R.AQ...QV........F..VL.EQDLRI..A.D.VER  57
NP_744505     19   .R.AQ...QV........F..VL.ATDLR...A.E.VEH  57
NP_945475     15   VDLSS.D..LVQY.EA......M..V.EQ.DR..HA.A.C.A  56
YP_001268649  12   .R.AQ...QV........F..VL.ATDLC...A.E.VEH  50
NP_791725     10   .VLLA..AD...QF..A.....L.F.LKEPELTI..V.A.VQS  52
YP_569510     15   VDLST.D..LVQY.EA......M..V.DQ.HLIMHA.A.C.E  56
YP_347894     15   ..AD...RF..A.....L...LSEPDLSII.I.A.VE.  52
YP_001864851  16   .HD.K............I..ALSTQL-.IV.V.N.TQV  52
YP_660007     6    DV.LD..HK............Y..LFEPETLILQYC.E.V.D  48
YP_236574     10   .VLLA..AD...QF..A.....L.F.LAEPELTI..V.A.VQ.  52
NP_792460     15   .AALAE.A....R...A.....V..SVA.DPLCIE.V.A.C.K  57
YP_275602     10   .VLLA..AD...QF..A.....L.F.LEEPNLTI..V.A.VQS  52
YP_262277     15   ..AD...RS..A.....V...LSEPELRIQ.I.A.VEA  52
ZP_01050418   25   K.DLT..DK....LL.QV.S.AY.FVI.VLNKQLVRA.E.VFD  67
ZP_01623038   12   .DLT..D........Q.....V...FQEIDLTI..A.Q..ID  53
ZP_01094090   8    KVDLD..D..............V..AF.PQ.LVLRYW.Q...M  50
YP_235462     20   .AALAE.A....RV..A.....V..SVA.DPLCIE.V.A.C..  62
YP_780275     18   .....E..LA..........VVSEPEHRII.A.A...D  55
YP_001900695  26   A..SR.V..CLSEPDLRIH.V.E.LEA  52
YP_861991     10   KVDLSS..K.....I.TS.A..VIVAY.RK.SKIT.IGE.CKE  52
ZP_02008304   26   A..SR.V..CLSEPDLRIQ.V.E.LE.  52
YP_001242244  14   .LA.....Q..LA.......I..AVKEPDNL.I.A.T...A  54
YP_676783     12   VNLQ..DQ............F.IAITKETW.IRFC.E.VID  53
YP_570910     21   .D..A..LA..........AVTPEDLQIVHAGGET.A  57
YP_001203744  14   .LA.....Q..LA.......I..AVKEPDNV.I.A.I...E  54
YP_001196150  12   V.LT..DQ.......Q.....F.IGLT-NDWIIDYCTS.ISS  52
ZP_01061101   12   .VSLT..DK.....L.K..H..F.VAC.ASNHTITYC.D.ISA  54
ZP_01884257   5    QVDLT..DK.......K..SQ.F.IAV.IQ.YQ.TYV.D.ISA  47
YP_531190     17   .....E..LA..........VVSEPDHC.I.A.A...E  54
YP_487638     24   ....A..L............ALAPDDLRIVHA.GDTTL  60
YP_001135775  22   .DLD..A.........V..R.V.VVVREPEF..R.V.A.VEE  63
YP_001361736  20   DL..--..........A.....V..AVERGDHR.VVA.A...G  60
YP_001196265  12   V.LT...H.............F.IGL.SDL-KIDFCTA.ISL  52
YP_715500     20   ..D.........V....V..AVRADDDT.V.V.A.I.E  58
ZP_01227360   24   .D..............M..V..RGTLD.VA---G.GD  57
NP_252806     7    V.LA...D....V..A.......V.LRA-D.M..AA.E.IQA  47
YP_789005     7    V.LA...D....V..A.......IALRA-D.M..AA.E.IQA  47
YP_001417343  20   .D.....R..A.....L..V..SRT---.KVVAA.GD  53
ZP_00973293   7    V.LA...D....V..A.......IALRA-D.M..AA.E.IQA  47
ZP_02055103   182  .............NAVM.A..AA.L.I.AF.A...D  218
YP_001641522  182  .............NAVM.A..AA.L.I.AF.A...D  218
ZP_00967488   7    V.LA...D....V..A.......V.LRA-D.M..AA.E.IQA  47
YP_570862     18   ...Q.Q..LA..........VISEPDHR.I.A.A...E  55
YP_001239104  30   .D....RT..A.....L..GL.PEELRITHAGGDV.G  66
ZP_01439288   24   ..D.....LL.AV.DF.-F.V.VSFDWLIQRV.A.IES  60
YP_245299     13   .A........L...Y.V..VI.PAD.RIV.A.TT..D  49
NP_639488     13   .A........L...Y.V..VI.PAD.RIV.A.TT..D  49
YP_487589     18   ...Q.Q..LA..........VISEPDHRIV.A.A...E  55
YP_001770032  151  .DPDL.A.....V..A....AV..AC.AATLT.AAC.A...E  192
YP_001238408  4    QVNLT..D.....V...V..F.F..ALVSDF-TICMA.E..PD  45
YP_485786     15   .D........A......F.A.RVDTSV.THA.A.LDE  51
YP_001346361  7    V.LA...D....V..A.........ALRA-D.M..AA.E.IQA  47
YP_198931     13   .A........L...Y.V..VIEPAD.RIV.A.ST..E  49
YP_366123     13   .A........L...Y.V..VIEPAD.RIV.A.ST..D  49
NP_355125     12   ..D........Y.....C.IAC.NAMRM..RH.E.CGE  49
NP_644587     13   .AQ.......L...Y.V..VIEPAD.RIV.A.ST..D  49
ZP_01302507   17   VDLS..D......L.AV..F.F.....WL---.ARA.A.S.Q  57
YP_001170431  10   ..T...AT..A.......V..QAD..L.AHA.A.L.E  46
YP_001204102  5    VNLT..D.....V...V..F.F..ALVSDF-TICMA.E..PD  45
YP_971319     14   .LD..D...........D....VAF..-D.V.RYA.A..ED  53
ZP_01017885   17   ..D.....QL.H..SF.F.FCLSS-DWSI.KV.E.VNQ  53
ZP_01157401   11   .V.L...A.....VL.R...F.C.IAVS..A------.A.TDD  52
YP_742336     14   .A.A...V....AV..S.C.VSL.QRLRRL..A.A.LHR  52
ZP_00998358   24   ..D.....KL.AV.SY.C.VVLSA-DWI..HA.A.VKS  60
NP_946341     4    KVDLTS.D...........C.C..AC.AQAVRITRI.E..GA  46
YP_611325     16   .LDS.DS....LS.L..NT...IVQ.PET.LIIGA.E..HL  56
YP_001749437  6    DVNLT..D....Q.........C..AC.ASASL..RH.V.TSQ  48
YP_192038     26   S.D.....R.DA...Y.L..VV.ST.LKIIG---G.GD  60
YP_001668821  6    QVNLT..D....QT........C..AC.ASATV..RH.V..PD  48
ZP_01545930   3    QVDLT..D.....LL.KV.SF.F.I-.TTPDWIISHV.R.VSQ  44
YP_001523831  11   ..D..............C.IACTPDA.HI.CH.A...D  48
NP_745504     6    QVNLT..D....Q.........C..AC.ASATV..RH.V..PQ  48
YP_345327     13   ..M...AT..A.......M..RAD..R.AHA.V.LGE  49
YP_001520152  5    .LAIS..D...V....R..IF...IAT.K.LESITHV.S.ISD  47
YP_001267717  7    VNLT..D....Q.........C..AC.ASATV..RH.V..PQ  48
YP_345384     62   ..M...AT..A.......M..RAD..R.AHA.V.LGE  98
YP_001372987  7    VNLT..D...............M.VM.QSGQNL.FA.A.IPC  48
ZP_01011420   19   ..D.....LL.RV.SY...V-.LSPDWVIQHA.E.LG.  55
ZP_01864718   7    DVDLT..D.....RL.H..AF...IAVNA-DWFLA.R.A.LQS  48
YP_769292     12   ..D.....QL..V..F.F..AVSS-DWI.MRA.A.L.E  48
ZP_00208733   13   QG..S.RL.LS.E...F....RL.P-D.Q.SHA.A.CGA  50
ZP_01726549   7    QLNFDR..D......EL..GY.Y.FALEEQ....KIV.D.IS.  49
NP_946838     30   L..A....A...ALAPADLTIVHAAGAT.S  59
YP_745313     24   .D.....M..A.....F.I-.VSRLWN.THV.A.I.D  59
ZP_01041311   13   .D.....NIAAV.SF.GM.VTNSE-WVIS.R.V.C.K  48
ZP_01748188   18   ..D.....QL.RV.SY....AVTT-DWI.QHA.E.LGD  54
ZP_01109672   11   .R..D......E.V.SY.F.IAFSYDDLNISIV.E.CE.  49
ZP_01884592   12   .GSL.LQHINL..DY.Y..IL.IEDLK.I.A.E.TDA  48
YP_677848     11   .GSL..SFVNQ..DY.F..VC.P-ALI...V.D..EA  46
ZP_01110306   12   Q...D.A..LIE.V.SF.YVIAINPDTKK.QVF.E.IKD  50
ZP_01109728   15   .DK....LL.K..NQ.FMVIV.-KA.V.THL.E.LEH  50
YP_427322     17   .DQ....V..LV....F.VVL.SK..RIA.VTPGIEA  53
ZP_00514108   20   ........V..VI.IKTFTII.V.E.TKR  48
ZP_01043109   10   .EAMK..AK..VQA.QCV.EN.M..AV.KRG.QIIAV.D.SDA  53
ZP_01051640   19   ...NN...EWIE.V.S..V..AF.FD.LI.THA.K.LD.  57
ZP_01736013   12   .KKRLQET.F...Q.V..AL.SQFF-IQHC.E.VDE  46
ZP_01446334   18   D.D.....QL.RV.SY....-.LSTDWI.QHA.E.LEA  54
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Query          61    FLGQEPTVLRGQTLAALLPEQWPALQAALPPGCPDALQYRATLDWPAAGHLSLTVHRVGE  120
NP_285374      61    ............................................................  120
YP_488045      67    V..LS.EAVLAEP.S.H.SADSA..SGD.AAAN.LHVEF---.TSSGTRTFNGIL..HDS  128
YP_569534      66    MI.IP.ETALAEP.S.YMT.SFAL.R...SDDD.IR.EF-L.KSA.I.--FNGIL..HDG  128
YP_533633      65    .T..S.EAVLS.SI...MTASFER.T.V.--AS..LAAFNPI.TSKGVRVCNGIM..HDG  127
NP_442237      52    I..RS.ED.L.R..GEVFDS.IDPI.SR.TA.QISS.NPSKL--.ARVMGDDFVI..NSD  115
ZP_01628825    54    LF.LH.EE.LNKN.NYF.ETDQIS.ESLVQEDL.IVNPIEL.INLKNEPNFDGII..SHG  116
NP_486939      54    I..RH.EQ.LN.H.SC..E..LSL.KDC.---AQED..IINP.EFIIKS.FDVIA..SNN  116
YP_321522      54    L..RH.EQ.LN.H.SC..E..INL..DC.TQ---ED..IINP.EFIIKS.FDVIA..SNG  116
YP_488044      49    .ADLG.DD.L.RS....DADSQAR.RS.MAS.S.V.IRL.RR-----DAEFTGLW..H.G  109
ZP_01459223    50    L..RP.ET.L..PVGRV..A..EP.V.V..A.A-----...L.------------.ESDG  102
NP_948356      65    L.R.P.AS.LNVPI.HY.TAASA..TH..HG.D.A.INI.LDVVT.DGERFNGIL..HDS  127
YP_569533      49    .VDL..GE.L..S.K..DSDSHMR.RK.MAS.S.I.IRLH--------..FTGLW..H.G  109
YP_779569      52    .A.LH.SQILQRPI.E..DDESAH.RRS..D.VAGS.LPIRFAQRRE.EFTG.W-..HDG  113
ZP_01623500    53    VF.IS.EQMLEK..ED...F.IERI.TG.---FQ.N.D.NP.KI.IRIRGDEYV...NSD  116
YP_324352      52    I..IKTEDILQKK.ED..DS.IERI..G.SS.N.TKIWI.KKG.DY.V--FDAVF..NT.  115
NP_948355      51    LT.LAIGA.I.RSA.DVFD.THNR.TI..AE.A.I.VGFTMRK.AGFV.----SW..HDQ  112
NP_487197      52    I..INAENILQKK.ED..DS.IERI.SG.SS.N.TKIWI.KKG.DY.V--FDAVF..NT.  115
YP_779570      65    L..VP.EAVLAAP.SSF.SDSSL..ST..SKEDIA.ANPIRIELHT...ERQFNL..HDS  127
ZP_01630443    52    IF.IH.ENILQTK.ED...F.IERIKTGISE.N.TKIWV.RKG.EY.V--FDAVF..NS.  115
YP_001894923   52    LT.LPAEHAL..PI.QIVGDE.AEREEGI.LYVGSMNDP..NVAGSP.APFAVI...YQG  120
YP_001863766   52    VF.IA.ENMLHKK.ED...F.IERIKTG.SGENL.FIN--P.KV.VRKKGDEYV...IEG  116
YP_001174646   53    W.DV.ARQ.L..P.S....IE--RI..G.------...SDVQ.TL.G..D.A.MA..HQG  116
ZP_01461267    55    V..NSAEQ.L.AP.GHFI.SVREP.E.D.RSARLKQ.NPLKVV-.RVD.FFDGIA..HQG  117
ZP_01730981    53    .F.IT.EEIIKL..DNIFDS.IEQ.KTG.ESNNL.FIKLW.RV.GDNYVIFDGVF..IEG  117
NP_354963      48    YI.VDLPIGAVA.E.N.---PFISVLS.WYS.EESNFR.A----.-.EKK.DVSA..S.T  99
YP_608942      52    W..VPALE.P.RAFD..VS.DFDLR.TS..EDF.FHIDV.LREGA.CQAP.RVLA..HDQ  116
YP_001668195   51    W..LPAQE.I.CPF.N.VSDGFD-.H.H.ARLPE.EIDV.LRQGA.HSEP.H.LA.CHD.  115
YP_001769101   53    RS.RPVAA.L..P.REAF..LRD.VASGMAEHAEEGAR.LR..TL.T.YD.A.--..SEG  116
YP_001748669   58    W..VPARE.L.C.F.DVVSDSFD-.R.H.E..-D.VFPFHIRNGA.CGDR.R.LT..HDQ  122
NP_744505      58    W..LPARE.I.CHF.D.VH.GFD-.H.H.TRLPE.EVDV.LRQGA.ISAL.HML..CHDQ  122
NP_945475      57    .I.KP.EAVI.API..V.GAG.HE.LGS.HDSG.VNIARESF.GSDQGW..F--A..C.G  118
YP_001268649   51    W..LPARE.I.CHF.D.VH.GFD-.H.H.TRLPE.EVDV.LRQGA.ISAQ.HML..CHDQ  115
NP_791725      53    V..KV.DQ.A....DCV.GAG.A--EVIRSTSAN.S.VDVPR.LMSVE.EFEALL..SQ.  111
YP_569510      57    ...KPLEAVV.S.V..V.GPA.RD.T.T..LDSGPVNIA.ESFVGTER.-FN.FA..C.G  118
YP_347894      53    L.ARPAQE.I..P.QS.IGDAHA.QVR-------E...QA.LS.A.PL-.FR.NL..HQD  111
YP_001864851   53    Y.CKA.ED.L.RP.SY...QPVEIVKQC.VKKVGS.NAFKVLINTLYGEYFDAIA..TE.  114
YP_660007      49    LMQCSLDA.L..S.DSIFDREFATKVK..DAALAQ..NSNT.IKTQSTYNAI.SL.--DD  132
YP_236574      53    V..HV.EQ.L.KG.DCV.GAG.AEVS.SAHDSFI..QRLLMSIN---GIEFEALL..HQG  111
NP_792460      58    S..L.SAE.L..P.SI..SAAHSM...YSQ.AM.NSDPI.L.V---R.VDYNASLS.A.D  116
YP_275602      53    V..HA.EHVL.KG.DHV.GAG.AEVS.SAHDSFV..QRLLM.VN---GIEFEALM..NQG  111
YP_262277      53    L...PAAQVL..P.EQ..-------------.DT.GQRI.EV.QL.RLS..AVNL..HQG  111
ZP_01050418    68    L.SRKREDIHTI..KDIFGPSA.TIASHIEG------KNTQ.IEAEVV.KRYVVI.YREN  122
ZP_01623038    54    ...V.AQS.L.KK.NDIFVD.AVSQNIDFDYFN.FEIRPKN.SCY.---QFEGVI..IDD  117
ZP_01094090    51    L..RKV.LTEAR.A..IISQES..VVVPIDG.ATIGREDE-NIRHT..A..-----.AGML  114
YP_235462      63    EF.MAADE.L.KP.SW.....SALIDH.YG.AA.HIDPIKL.I---GTA.Y.ASLQ.ADD  121
YP_780275      56    ..R.KQVL.D.DL.IRI..HLD.D.DR-..I.N.T.-EFDCL.HR.PE.G.VVEFE.A.P  125
YP_001900695   53    A..TPA.A.QAPVDHVIGTAGREV.ER..GTHSI.GHP.IG..LT.HGHA.DAV...HKG  114
YP_861991      53    LF.ISAED.L..G.ESIFSKN-------VTQRITNS.KEDGVF.IEET.KKFIVIPQIS.  109
ZP_02008304    53    A..TPAAA.QAPVDHVTGAAGREV.ER..ATQSI.GHP.IG..QT.HGHA.DAV...HKG  114
YP_001242244   55    ..NTNSV..G.DLALQI..HLNGP.HL.-------PMTL.CAVGT.PR-RVDC.I..PSN  112
YP_676783      54    .I.LSHKQ.L.KKITEIFDDIFKVI.-------.K.YAVGESK.IQGKIEEFDF.A.QNED  111
YP_570910      58    L..VSIES.A.VSAFTIFSD.IAR.R.L.G.DRKIERPLH...KAAD.TPVDVV..QASG  119
YP_001203744   55    ..NTNSV..G.DLALQI..HLNGP.HL.-------PMTL.C.VGS.PR-RVDC....PSN  112
YP_001196150   53    .IPLSH.QAL.NKF..VFGT.--.QERIFSYINS.TV.DVFP.EIELLNEFQVNI.KSDD  111
ZP_01061101    55    LFDKSAEDIL.SS.SD..S.TITQDVLKTTS.-----KKSISIQLKLKDEVYVLLSHIN.  109
ZP_01884257    48    YVETSAG..LNLHVS-V.A.HV..FPSS.DGRSQ.SFD.KVLI.S.----FY.IIYTS.A  114
YP_531190      55    ..NLKQVL.D.DL.IQI..HLD.TAEGMIAVR.RP..EFDCL.HR.PE.G.IVELE.A.S  124
YP_487638      61    LP.APAGP.P.RHATEI.SD.IAR.R.L.G.DRRIERPLH.A.TA.D.TPIDVV..QSSG  122
YP_001135775   64    L..HPVESVL.RH.S..MGASQA..HRRN.VE.--V.DV.GS.EFD.IL.-----REP.G  128
YP_001361736   61    .F.RPLPEVLSSS..D..GADLTVRG.D.LDNLDEV.HA.LPGPGGS..EADVVL.VS..  126
YP_001196265   53    .VDLQH.DIL.KNFT.IFGSKQQ--KQI.DYINE.KI.NVFP.EINLL.KFQVSI.KSYD  111
YP_715500      59    T..R.AAATI.RP.RE.VGD-------.AAKAVR.VV--.TAF.LRG..PVD.V......  122
ZP_01227360    58    IE.RLAPQWL.RP..S.IGSA--.VEI..--.IE.--ETS.V..-.VT.S.DGVA..T..  113
ZP_01728373    51                                                          I..YDQ  56
NP_252806      48    L..FVASPGSYL.QEQVG..VLRM.EEG.TGNG.----WSNSVETRIGE..FDVI.SYK.  104
YP_789005      48    L..-----FVASPGSY.T...G.EVLRM.EE.LTGNGPWSNSVETRIGE..FDVI.SYK.  104
YP_001417343   54    VE.RLAADWA.RD.G...GRDVA..LG.AAV.TVRVGRVAGRDET-----FEVQI.AS.R  108
ZP_00973293    48    L..FVASPGSYL.QEQVG..VLRM.EEG.TGNG.----WSNSVETRIGE..FDVI.SYK.  104
ZP_02055103    219   V.APDLFPPN.LN.E.V..---G.IVS.IRD.LT.GRLL.RS.TL.PR...VAHA.LGRV  283
YP_001641522   219   V.APDLFPPN.LN.E.V..---G.IVS.IRD.LT.GRLL.RS.TL.PR...VAHA.LGRV  283
ZP_00967488    48    L..FVASPGSYL.QEQVG..VLRM.EEG.TGNG.----WSNSVETRIGE..FDVI.SYK.  104
YP_570862      56    ..NL.CLL.D.DL.MRI..HLD.PSE-----.T.I.VRC.GLIHR..E.G.IVELE.A.P  125
YP_001239104   67    L.TAA.QT.L.DSASR.F.D.MRQ.RMLAGGAG.QRAVHAFSMAGHSEANADVIAF.S.A  127
ZP_01439288    61    .T.RSVDD.L.AP.NT..GDNVIH.IRSRLQSSE.GTEHVFGI.FLSN.RFDVSL.VS.S  123
YP_245299      50    L..VPMAA.L.M.QVLT...AQ.FAVDDQ.QHLMH.FPQ...PP.V..W..------YPQ  111
NP_639488      50    L..VPMAA.L.M.QVLT...AQ.FAVDDQ.QHLMH.FPQ...PP.V..W..------YPQ  111
YP_487589      56    ..NV.RVL.E.DL.IRI..HLD.TSEGTCRI.S.G.-DFDGLIHR.LE.G.IVELE.A.P  125
YP_001770032   193   T..AA.L---.RP..G...DP---.V..IRAAAAS.WEAGRI.R..GGAPHEVLA..S.A  251
YP_001238408   46    Y..GDIGG.LQ.PI..V.S---..GV..IRSRV...VERIFGI.LLGK.R.D.AI.FS.A  108
YP_485786      52    M..ISAGAAL....RQSI--------G..AS.TI..ISRDHSALYQLS.D.H..AY...P  108
YP_001346361   48    L..APGSY.QE.QVG.----.VLRM.EDG.LG.G.----WANSVETRIGE..FDVI.SYKD  104
YP_198931      50    L..VPMDA.L.MAYTQV..DAQ.GAVDDQ.QHVLH.P.RS.PT..V..W..------YP.  111
YP_366123      50    L..VPMDA.L.MPYTQV.E-----.PD.Q.FAVD.QP.HLLHA..V..W..------YP.  111
NP_355125      50    L..L.GD-.N.R.AEDV.GKKLV..TVTGRTTR.AM.PAME.S.GRS---FDISL..YKS  110
NP_644587      50    L..VPMDA.L.TPYTQV.E-----.PD.Q.FAVD.QP.HLLHA..V..W..------YP.  111
ZP_01302507    58    .I.LS.DDML.RPV.DIFEAD--.IH.T.LR.-.SVERLFS..G..---FDVA..FS.P  120
YP_001170431   47    I..LPAAAAL.RPICDVIGHVNEV.LREARRRGSET.ESIGS.RRADGRL.H.HAFQS.D  106
YP_001204102   46    ..DGDIGW.LHKS.G.VVC.SAE.AIR.RVDSG...VERVFGV.LQGQ.R.D.AI.FS.A  108
YP_971319      54    L..CP--LVP.SV.EG...QAPCSAV.DKVREGLM..RGE.EVPM..SRQFDVVL.ISDK  116
ZP_01017885    54    ..PLQVSD.V.EHASRV..DALHD.RSQ.QMSHE.SVERVFH.QFSCTDY.DVAL.MS.R  117
ZP_01157401    53    I.DLA.ER.V.APF.DFF.G.SHD.RSKMQLLAH.DQPA.VRF.LFED.R.DIAI.GS.R  115
YP_742336      53    .F.VT.EQALASDPK...GRHLRRIS.S..QAPLQPVSLV.GMRLRGRNRFRT.AY.S..  114
ZP_00998358    61    ...W.AADMP.RP.SEM..HASLSKLR.KLS.LLH.DATARLI.VDLF.DFDASI..S.R  123
NP_946341      47    .F.R.-.PRV.EL..DYFG.EAH..RN..AQSS-.PKRPALIFG.RTGRTFDISL..HDG  108
YP_611325      57    ...RPVEAIL.FS.TEIA.DI--.DEL.E.DNVHEI.ESQRNV.-DCVYDTICH....I.  120
YP_001749437   49    M...RLEAII.IEA.HTVRNSLARVKE.SR.----.-SFGVP.---.S.QFDVSA.LFKG  109
YP_192038      61    IE.RLAPDWL.RP..DI.KIPESR.HDEKR.SLS.-.RVAGLK.ET----F.ILR.AQ.T  115
YP_001668821   49    V..ITGDI-N..K.Q.V.GDEVAT.RN..AEASRP..SFSVR.--.NGQAFDVAA.LFKG  109
ZP_01545930    45    YVPFS.EDML.KRALD.I..SIH.IRNR.Q.RRGVEVV.NLK.EGTDCP-FDVSI.ALES  107
YP_001523831   49    V.HLPSAGIN.LR.E.V.GGKAA..TT.TD.AR.GL.LGLNI----GERAFDVA..IYKG  109
NP_745504      49    M..VANDI-N..K.H.V.GDEVTT.RN..ADASRP..SFGV..--.NGAAVDIAA.LYKG  109
YP_345327      50    I..LPAASVL.APIGEVIGRVNEI.LREARRSGSETPETIGSFRRSDGQL.H.HAFQS.D  109
YP_001520152   48    ...VT.ADAL..S.SI....EVIHTLRNI-A.H.TIATH.ERAGY.LQSM.DISL..L.P  108
YP_001267717   49    M..VANDI-N..K.H.V.GDEVTT.RN..ADASRP..SFGV..--.NGEAVDIAA.LYKG  109
YP_345384      99    I..LPAASVL.APIGEVIGRVNEI.LREARRSGSETPETIGSFRRSDGQL.H.HAFQS.D  158
YP_001372987   49    IT.YRGDLIP.IAISLIVG.KNA.AAK.RE..LSSVV---LG.RF.GKSL.DAVI.THKG  111
ZP_01011420    56    I.DHHDGEVI..NIDEIVDASAI..RT.MTR.--.IT.TAVR.ELKNN.R.D.SL.QSDQ  118
ZP_01864718    49    I..T.REPEV.VR.SQIIAPRGS.VA.LID.DQTER.FGVDL..--DG.LFDCAI.TS.H  111
YP_769292      49    ..ET.ANAIGRPV.SLIT..ALHTIRNK.TT.SDVVERIFGIALM.DQNRFD.A..LN.G  111
ZP_00208733    51    V..IP.EA.L..IPGP..GGL-VG.DELT.L.GFPI.RTK.---FT.H.D.D.A.SPS..  107
ZP_01726549    50    L.Q.HEDI.-.KNFFE..D.D.QFI.ETYERARTRQ..VVFRNEVLI..NFYAVLYSS.S  118
NP_946838      60    L..AAAEL.P.TAAS.FSSD.IAR....TAERWIERP.HAF..NA.D.TPIDVI..HASG  121
YP_745313      60    YVPASASKVL.AS.IT....TVH..RG.VQMLGSA.MTE.LK.HHD.ESA.DFSI.IMAD  124
ZP_01041311    49    L.AIDALPEP.TN..DIIESA--....LREAASA..VERIFGIRFTEEAE.DCAL.CSEG  111
ZP_01748188    55    I..IDHGDAI.RR.QE.IVDAFERMRKSM.D.VVRLFGVTVLN.NRS---FDVSL.GS.R  117
ZP_01109672    50    IFAEGIVI.SSD.NE.F.E.TFDRVSKSKIRLPIKLILNK.L.KEGE.KDYLAV.YDS.H  116
ZP_01884592    49    IT.KPQEIINSSFSEYIIDTDFEKIREF.KK.VTQKIPFSLSFNTE.SDQFHALM.IKAD  110
YP_677848      47    .TRISYQSFIDKN.KE..TDSFQL..EK.SSKAQK--RFTC..EFYGGVRT.FLI.VKE.  107
ZP_01110306    51    LFKV.--IVA.E..VTE.IDI-.SPD.PTFKTIHN..KV.HAYQ.KF.KNA.GVAFDSNG  120
ZP_01109728    51    .ANVTRDN.I..S.WE..DRKLV.IRG.QSQAVISKAT.LHSISI.CEDKFD.CI.QSA.  113
YP_427322      54    VA.VVAQR.I.EP.ERV.DP.RCRHRI.R..HLI.PFPV.----.GGQSF.AVA.ATDQ  114
ZP_00514108    49    ...VK.KT.L.KP.TY.MYK.IKNIKNI.ENNFV.IIKLKKKY.TQFK.----IF...QD  108
ZP_01043109    54    V..CPCDA.M.SF..ECM.SDFLTSFK.ADEKLKQGSD.EI-FA.E.GEQSFFSIYYSQA  113
ZP_01051640    58    I.KLDAKAALSKSIREVFNKD--DVHDI.NIASHNSTKF.EHIKVTSE.SIDISLF.TEN  118
ZP_01736013    47    L.QLPY.AVL.RNFD----------EF.NTADIEQI.SLKGLG..RSS.V.N.RIR.GNN  96
ZP_01446334    55    I..IPAEAAL.RP.HE.IVSDGRIR.NLRVVELQ.GVLRLFNVTMQ.S.KFDVS..GS.R  117
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Query          121  LLILEFEPTEAWDSTGPHALRNAMFALESAPNLRALAEVATQTVRELTGFDRVMLYKFAP  180
NP_285374      121  ............................................................  180
YP_488045      129  .C...L..RDTTE.SSERSV.A.IRR.QK.TSVLMACDI.ARE..RI.....IKI.R.SA  190
YP_569534      129  .C...L..RG.TE.SSERSV.A.IRR.QK.SSVLMACDI.ARE..RI.....IKI.R..A  190
YP_533633      128  .T...L..RP.GAEPPAESV.A.IRR.QT.SD.LTVCNI.ARE..R.......KI.R.DK  190
NP_442237      117  ..VC.L..AYTS.NLPY.MANA.LNR.RQQA...DFYD.IVEE..RM.........R.DE  180
ZP_01628825    117  V....L...K.EK.NTY.LVKM..SK.Q..S..AEISQIVVKE.KKI.........R.DQ  180
NP_486939      117  .....L.ANLS-.K.HS.LVKL..LK.QGTATTTEISQILA.E..KI.......V.R.DE  180
YP_321522      117  .....L.ANLSDKNYSY.LVKL..LK.QG.ATTTEISQILA.E..KI.......V.R.DE  180
YP_488044      110  .TF..L.-VPRHEAAES..FSG.IKR.QA.QS.EGACSA.ARE...I.E....KI.R...  172
ZP_01459223    103  .TV..L..A.GMEE.ALEVV.RLVSP.AGVKGTQ..LQT.AD...A........V.R.DA  165
NP_948356      128  IV...L..RDESRY.NERSV.V.IRR.QT.AD.PTACWI.ASE..RI.....IKV.Q..A  189
YP_569533      110  .AF..L.-VPLHEAAES..FSG.IKR.QA.QT.QGACAA.ACE...I.E....KI.R..S  172
YP_779569      114  .IV..V..PQH-ETSES..FSG.IRR.QA.QT.E.ACAA.ARE...I......KV.R.GS  176
ZP_01623500    118  F....L..ATSQENSFY.LA.MSINQ..ETAS.HEFCQIIV.E..KV.A.........DE  181
YP_324352      117  F....L..AITQENSFY.LAKASINQ.QKTA...DFCQIIV.E..KV.D.........DD  180
NP_948355      113  .VF..L..PQR-.VAE.Q.FNS.IRR.QA.ET.ESACAA.A.E...I.......I.R..S  175
NP_487197      117  F....L..AITQENSFY.LAKASINQ.QKTA...DFCQIIV.E..KV.D.........DD  180
YP_779570      128  .TF..L..RDDVH.SHERSV.A.IHR.QA.SD.A.ASDI.AREIHRI......KV.R.SA  189
ZP_01630443    117  F....L..AVSRENSFY.LAKASINQ..TTA..HDFCQIIV.E..KV...........DD  180
YP_001894923   121  VV.V.L..ADVFS.MY.-LV.TFINR..DVQTVAG..QL.ADE.QRI..YG.TLV.S.DG  183
YP_001863766   117  F....L..AITQENSFY.LA.ASINQ..KTA...DFCQ.IV.E..KI.E.........DD  180
YP_001174646   117  Q......RAQ.YQALY.-LM.TFVSR.QE.RE.E..CQH.VEE.KRI...G..KA.R.DA  179
ZP_01461267    118  R....L..SSHREAVPF..V.DGLSR.RD.RD.QE.C.AVV.E..G......AII.R.DA  181
ZP_01730981    118  F....L..AISQENSFY.LAKASINQ.Q.NA..TDFCQIIVKE..KM...........DE  181
NP_354963      100  .V...V.KAGVGE.AEKGE.TSLAKY.N...S.EDALFRTA.L.SSIS.H..TLI.D.GL  161
YP_608942      117  V.......CRGSAKGDYYP.VR.FVS.HQ.TSIED.LQQSVRQIKRI...G..KA.R.DT  177
YP_001668195   116  V..A....PR.GQGDYYPLV..FVGS.QL.TS.ED.LQQTVVQLKRI...G..KA.R.DA  180
YP_001769101   117  .IV..L.--.SSEAA.TD.SLD.LHG.HG.GSVPE.CALLARDI.HI.....ALV.R.DR  182
YP_001748669   123  V..A....VR--QPL..PLV.GFVSS.NN.AT.EE.LQQTVLQIKRI...G..KA.S.DT  187
NP_744505      123  V..A....PRLA.LV.QGLV.SFVAS.QV.SSIED.LQQTVLQLKRI...G..KA.R.DA  187
NP_945475      119  .I.....KA.P-EAA.TTSV.ADLA..QATEGVQ.FFDL.VERI.AF..Y....A.R..E  182
YP_001268649   116  V..A....PRLA.LV.QGLV.SFVAS.QV.SSIED.LQQTVLQFKRI...G..KA.R.DA  180
NP_791725      112  A.V..L.IQDKAAQAISYSE.TGNMG.HA.AD.QT.Y..SVREIQRM..Y...LI.R.EE  176
YP_569510      119  .I...L.KSA.-.GS.VSPV.ADLAR.QD.NS.KDFFDL.VARI.AF..Y....A.R.DV  182
YP_347894      112  V.....Q.RNV-AG.ET.-.GRMLAR.QK.QS.Q..YDISVKEIQAM..Y...LI.R.EE  176
YP_001864851   115  AV...L...DSEFEVSF.SFASEAI.MQRTS..GEFLHLVA.E.QKIIS.....V.Q.DE  178
YP_660007      133  ..AI.L..ALSAS.SSFNPVK.SLND.AQSQD.NNVFAYSVNEI.KV...........DA  196
YP_236574      112  V.V..L.IQGKDAQSVSYSE.TGNMG.HA.SD.QT.Y..SVREIQKM..Y...LI.R.EE  176
NP_792460      117  V..I.L..FVEAAHEQSRIITRVLRN.QA.TT.ET.FDIGVHEIQA...Y.....I.R.E.  176
YP_275602      112  V.V..L.IQDKDAQAVSYTE.TGNMG.HA.SD.QT.Y..SVREIQRM..Y...LI.R.EE  176
ZP_00516991    1                                                  M..........DE  14
YP_262277      112  V.M..L..QHLKEQ.--EN.GRLLRR.QT.KT.NE.YAISVSEIQAM..Y...LI.R.EE  176
ZP_01050418    123  .IYI.L..IV.QAEAHQRQ.SDIITD.SQ.ITVSEMCDKTANLIKS...Y.......DQ  184
ZP_01623038    118  I.C..L.LKSNSQISY.LSFYHLLK..K.IV.VDDFQ.STH.L...I..Y....I.Q.EE  181
ZP_01094090    115  ..EI.IA.IDKIH.RA.RL.KT.THRMQACQTMEE.YSAIATQIKS.S.......I.R.LE  178
YP_235462      122  V..I.L..FVETGHGQSRIITRVLRN.QA.TT.ET.FDISVHEIQA...Y.....I.R.E.  181
YP_780275      126  A.D.-----------.EQIES.LE.IRA.NT....CDETAGLF..R..Y....V.R.DE  173
YP_001900695   115  T....V..AM.FA.MY.-LV.TFVAS.QAVGTID..TDL.ARE.HH..H.G..TI.RIER  178
NP_861991      110  N...DI.KR.SY.FQ--KE.SSLLNT.TASRTAEE.CND.ARITKSIFEY.....I...DE  171
ZP_02008304    115  T....L..AV.FV.MY.-LV.TFVGS.QA.GTID..TDL.ARE..R..N.G..TI.RIDS  178
YP_001242244   113  G..I.L..ATKTTNIA.-..DG.FHRIT..SS.LG.SDETATIFK.I..Y....V.R.DD  172
YP_676783      112  VI...S.IHI--.N.PKND.KQF.DYM.DSHT.IR.C.LVASGIKKV.DY....I.R.DK  173
YP_570910      120  ..V.....RREPAPNNSL..VQS.IRVQR.GTVQ.FCDAVVAE..AV.......I.R.M.  180
YP_001203744   113  G..V.L..ATKTTNVA.-..DG.FHRIT.SSS.IG.CDETATIF..I..Y....V.R.DE  172
YP_001196150   112  IYV..A..QFDKQILADVYTQTIQ.VMNNTKS.KD.CALVAEGT..I..Y....I.R.DE  173
ZP_01061101    111  N.V.....LQ--..GD.YNYQ.QLSE.NA.TDEQEMCD.TATLIK.FF.Y....I.R.DE  172
ZP_01884257    115  EYVM....ITL-.FDIQNLIGRSVSRILATHS.SD.LGN.ALE.KQ.IEY....I...HD  173
YP_531190      125  S.D.LEQ-----------IAT.LE.IR.TTS.SG.CDQ.AALY.DR..Y....V.R.DD  172
YP_487638      123  ..V...D.RREPAPENSL..VQS.IRVQR.GTVQ.FC.AIVAEL.AV...E...I.R.SA  183
YP_001135775   129  V.LV.L.VAG.RPYSF.N.V.SSVE..NR.TTMAD.YDT.ARS...........V.RYDE  192
YP_001361736   127  R.VV.I..SPP--H.A.R.T.G.IAR.AGTRGIEG.C.RLVRE..V........A.R.DA  187
YP_001196265   112  IYV..A.LKF.REKLADVYTQTIQ.VMNNTTS.KD.CALVAEGT..I..Y....I...DE  174
YP_715500      123  QVVI.LQA.RPLSYS.TY.T.QSVLR.S.SSS.TE.YD.VVEE..R........V.R.DA  186
ZP_01227360    114  Y.LI.L.DA.RAGASTARIIEE.GA..ARTHD.LD.C.A.V.QF.AI..Y....I.R.HE  176
ZP_01728373    57   V.F..L..Q.EISLIDFY.SEFSISQINNNLS.QE.CQISA.EI.K.S......I.Q.DH  120
NP_252806      105  VFY....IRT.DTLSITSFTL..QRIIAQVQDTAS.LSNV.DEL.RM..Y....A.R.RH  167
YP_789005      105  VFY....IRT.DTLSITSFTL..QRIIAQVQDTAS.LSNV.DEL.RM..Y....A.R.RH  167
YP_001417343   109  G.LV.L..AG.-----.L.AADILAG..Q..D....CAE.A.AF.RI.......I.Q.RE  170
ZP_00973293    105  VFY....IRT.DTLSITSFTL..QRIIAQVQDTAS.LSNV.DEL.RM..Y....A.R.RH  167
ZP_02055103    284  IVE..LA.ERPE.AAS.LDAEL..MR.RA.ES.TEA.QI.ALEI.AM...ES.LV.R.DT  345
YP_001641522   284  IVE..LA.ERPE.AAS.LDAEL..MR.RA.ES.TEA.QI.ALEI.AM...ES.LV.R.DT  345
ZP_00967488    105  VFY....IRT.DTLSITSFTL..QRIIAQVQDTAS.LSNV.DEL.RM..Y....A.R.RH  167
YP_570862      126  AID.A-------QMV..------.LEKIRT.NSI...C..TA.LFQDR..Y....V.R.DE  173
YP_001239104   128  V.VV.I.LRREQAPDN.L.AVKG.LRIQQTETAPSFCQAVVDE..H.I.......F.R.LD  188
ZP_01439288    124  SIVI.A..SDTHQTVT.G..VRS.SG.QRT.ST.D.F.ESVRQL.SV.........R.NT  184
YP_245299      112  QWLV.M..RD.L.V.-----..E..PL.R.VERDPGI..A.VRVL.S.I......I.R.DE  172
NP_639488      112  QWLV.M..RD.L.V.-----..E..PL.R.VERDPGI..A.VRVL.S.I......I.R.DE  172
YP_487589      126  PVD.SLMVGQ.L.K------------IRT.SSV...C.E.AVLFQNR..Y....I.R.DE  173
YP_001770032   252  RV.V.L.RVP.FAAASLAEVEE.IGH.RA.ET.AEA.R..AREA.R.....CILI.R.DA  315
YP_001238408   109  Y.VV.A..S.SGANS.-ELV.LMLGRIRKTTSMAD..QE.ARQLKL........V.R.H.  169
YP_485786      109  QVCIDV..VSP--.VA..RV.AVLD.FR..EGQ.E.CAL.VRSL..I..Y....A.R.DT  170
YP_001346361   105  VFY....T.DTLSI.SFTLNAQRII.QVQLH.DT..LSSV.EEL.RM..Y....A.R.RH  167
YP_198931      112  QWLI.I..RD.M.V.-----..E.LPL.R.IERDAGIE.A.AKGL.SMI......V.R.DE  172
YP_366123      112  QWLI.I..RD.M.V.-----..E.LPL.R.IERDAGID.A.VRAL.SMI......V.R.DE  172
NP_355125      111  TT.I....SGS-.AQPLGTA.KMVDRIRE.DSVES.ISRT.RL.KATL.Y....I.R.QE  169
NP_644587      112  QWLV.I..RD.M.V.-----..E.LPL.R.IERDAGID.A.VRAL.SMI......V.R.DE  172
ZP_01302507    121  MV.V.A..ASHDEMEASSTV.SMVSR.AQ.ESMS.FLRDGARQ..A........V.R..D  180
YP_001170431   107  YMC.DL.AVRDE.DRL.PG.TQSVIETF..AVTQV.C.L.VHGL.QV..Y....A.R.G.  167
YP_001204102   109  Y.VV.A..SLIEPGVNSGE.VRL.LGIRKTTGMID..QE.ARQLKL........V.R.H.  169
YP_971319      117  ..VA...SRRHSSAELAVFAVQ.HR.M.KLRRP...LQL..DEL.A........A.R.R.  179
ZP_01017885    118  SI.....RS.----.SQ.TV.SMIGRVQQSST.AD.SKM.SRH..A........V.R...  178
ZP_01157401    116  HFVF....KSSSEFRDDL..VQPLI.VRRREDIVGA.TE.ARCLKAM..L.....V.R.EE  176
YP_742336      115  RVV....ALSGP.T.LFP.MGDWLSH.AG.RTAG..L.TLVAAA.D...HE.A.V.Q.D.  175
ZP_00998358    124  SI.A...TDA.P.RDDLGSVQALVHRIAAHGTFGEKLDQ.VRGLKL.S......V.R..E  185
NP_946341      109  TS.V....AA.DQADN.LR.TRQII.--RTKE.KS.E.M.ARVP.Y.Q.YH...M.R..D  169
YP_611325      121  FVLN.-A.SASQARKRMRMSGP.CAQIMA..TFD.AMQI.CN...T....S..KI.R.L.  179
YP_001749437   110  TV......ASQSIAEPIELV.TVIAQ.REIDRSDR.VADTAKR..A.L.Y....I.QLGA  169
YP_192038      116  H.LI.L..V....IF.E--IDSTADRF.RC.DTTSVCRQGAAIF.R.......LV.R.ME  178
YP_001668821   110  TA......AG.SIAEPIELA.TLIAQ.REIEQTSK.FRD.ARF..AVL.Y....I.QLGT  169
ZP_01545930    108  NIVM.....LEGE.NDTANV...IDRMADL.QVE.IYSQ.VRFIKMV............T  169
YP_001523831   110  VV.I.C.AAPKGR.GT.VEFVR.LISQV.R.DV--.LRR.SHL..T.L.Y....I.R.DA  170
NP_745504      110  TA......AG.SIAEPIELA.TLIAQ.REIDQTHK.FRD.ARF..AVL.Y....I.QLGA  169
YP_345327      110  YMC.DI..VRDE.GRL.PGA.QSVITFS..MTQVE.C.L.VHGLQLVL.Y....A.R.GA  170
YP_001520152   109  HFLI.L.SVPSAQLNSQS.IQMLLAR.QDETATS..LQL.VKDLQQV.E.....A.Q.L.  171
YP_001267717   110  TA......AG.SIAEPIELA.TLIAQ.REIDQTHK.FRD.ARF..AVL.Y....I.QLGA  169
YP_345384      159  YMC.DI..VRDE.GRL.PGA.QSVITFS..MTQVE.C.L.VHGLQLVL.Y....A.R.GA  219
YP_001372987   112  RTFV.I..CADRGQSARQ...SVIHRIGREETVDKA.ATGVRL..AML.Y....V.R.LH  174
ZP_01011420    119  Y.......KA.--ER.SDVMSEVYPLIQNIDTTKD..QL.GDAA..IA...S..V.E.Q.  179
ZP_01864718    112  YT.I.I..H.EGKVNRQIG.LRPIV...KGESD.L...A.R.-L.LSLDI....V.R.HK  172
YP_769292      112  QV.I.G.RC.DRHDAASLSM.SM.SR.DHTET.E.FFREGARQA.A........V.R.DE  172
ZP_00208733    108  G.L......G--.FS.T.S.KE.IHL.H.-.TV..SFQIL.E.IAD...YG..LI.R..D  172
ZP_01726549    119  YQV..I..ATKFRQ.YSAKHYIKLYSMNV..S.ETM.REIVE.I.YISEME..V..R.NE  184
NP_946838      122  ..VV.LD.RREPAPENSL..VQS.IRARP....QGFCDAMAAEL.SV.......V.R..R  182
YP_745313      125  TYVI.A..SVCGK.G.SDVV.MMFGR.QQSRGIAP.FQE..RQI.A...Y....I.R..E  187
ZP_01041311    112  KF.I....HD.KGYADHLM.MG.LAQ..PIRD.DT.CRK.AKL.KQML.Y....I...Y.  172
ZP_01748188    118  HM.V....SDVMSEVY..I.Q-----.RGCVD.ET..RR..VALHK.S...S....Q.QA  178
ZP_01109672    117  HYVV.L..ATEFRDAYSAEQFIKLYSMSI..RFKS.G.M.QE.I.Y..NM...V....NE  182
ZP_01884592    111  Y.L..M.KATVETNRSFQEVKQIIA.IDQ.ATVKEVC...VHEL.KIS...GILM.Q.DK  174
YP_677848      108  YILF....SDDT.IK.YQQIHE.SA.IQQSQE.GESLSI.VKELKTFS...K..I...DE  171
ZP_01110306    121  ..VI.L.....AQQWV.MDI.ALLPNVDDKESIGDV.DAIAKVFKQYI...S..V.Q.DD  187
ZP_01109728    114  H......KL.---.A.KYVITAL.AQMSMFSE.DD.YQGLVES..TA..H......Q.LA  172
YP_427322      115  ADLV.LWSDDQ-ET.VEGVFGRLP..IGH.SRAASIEDL.AA..AD...YE...V.R..E  176
ZP_00514108    109  SI.G.L.TFKLN.NNKNKLFQD.IINTGKTND.KK.SAKI.EEI.KI.K....LI.R.EN  172
ZP_01043109    114  W.VV.T.I----.V.D.GLK.SCY...LDIS.TNSTEQTLQKLC...S.YE..LV.Q.DD  174
ZP_01051640    119  SVV..LM..-GE.FKYININN.IKW..AKTE.IEDILKN.V.SLQKI.......A...L.  180
ZP_01736013    97   W.LV.L.QA..Q.QNAFFGT.DLLWQ.NREQD.NSYTQKVAEL..QV..Y....M.Q.DH  175
ZP_00051672    1                               MAD.RDIDS.SAIV.EAIATIS..E..LV.R.DT  34
ZP_01446334    118  H..I....KV.--TR.RDM.AEVIS..SRNRD..S.TRA.ARGLQG.C...S..V.Q.Q.  178
YP_478662      3                ..T.-AAAARPS.D.LIQIRQSLE.DQILRATVEE..AFL.T...KV.R.D.  58
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Query          181   DATGEVIAEARREGLHAFLGHRFPASDIPAQARALYtrhllrltadtraaaVPLDPVLNP  240
NP_285374      181   ............................................................  240
YP_488045      191   .WS.Q....D.IDSIPSL.DFH.........S.....SNTV.IIP.IGYRPS..L.DR..  250
YP_569534      191   .WS.Q....D.VDSIPSL.DFH.........S.....SNTI.IIP.VAYRPS..L.DR..  250
YP_533633      191   .WN.Q.V..D.SDSIPS..DFH.........S.....SN.I.IIP.IGYRPA..I.DF..  250
NP_442237      181   NNH.D....DK.DDMEPY..LHY.E....QP..R.FIHNPI.VIP.VYGV....T.AV..  240
ZP_01628825    181   .WN.T....EKP.Y.T.Y..LHY......T...K..SQNW...IPN.YYQPAAIV.TN..  240
NP_486939      181   QWN.K....VKP.Y.TSY..LNY......Q...K..SQNW...IP.AKYQP..IV.IN..  240
YP_321522      181   QWN.K....V.P.Y.TSY..LHY......Q...K..SQNW...IP.AKYQP..IV.TNH.  240
YP_488044      173   .FS......D.T..VES...LH..P........R..ATNPI.IIP.IDYIP..IV.GHD.  232
ZP_01459223    166   .WH...L..SK.G.MDG...MH...T...V........NP...I..A..RP...L.PVV.  225
NP_948356      190   .WS.Q....D.DS.IPSL.DFH..S......S.....INPV.IIP.IGYRPS..V.DI..  249
YP_569533      173   .YS......D.A..VES...L...P....V...R...INPI.IIP.IDYIP..IV.GTD.  232
YP_779569      177   .LS.Q....D.S..VESY..LH..P........K..AINPV.IIPNIDYRP..IA.D...  236
ZP_01623500    182   EGH.V....DKI.E.EPY..LHY.E....KP..K.L.ENWI.IIP.AQ.Q..A.F.DK..  241
YP_324352      181   .GH.S....EKLDS.EPY..LHY.E....KP..K.FISNSI.VIPNAQ.Q.IQMI.SV..  240
NP_948355      176   .FS......D.CAEVESY..LH...........R...INPV.IIP.INYRP..VT.D...  235
NP_487197      181   .GH.S....EKLDS.EPY..LHY.E....KP..K.FISNSI.VIPNAQ.Q.IQMI.A...  240
YP_779570      190   .WS.Q....Y.VDSIPSL.DFH..S......S.....INTV.IIP.IGYSPC..V.DY..  249
ZP_01630443    181   .GH.S....EKL.SMEPY..LHY.E....KP..K.FVANSI.IIP.SH.QSIQII.AQ..  240
YP_001894923   184   TGS.H....HVEP.YASYADQH..G...........V.NRI..I..ADYRPA..V.P.H.  243
YP_001863766   181   .GH.S....EKL.S.EPY..LHY.E....KP..K.FAANSI.IIP.AYSQP.K.F..N..  240
YP_001174646   180   EDN.L.L..VADP.YPSY..LC...A...Q...R..RDN.I.VIQ.ANYKPS..V.T...  239
ZP_01461267    182   EWN.S......DARADPY..LH.......R...E..QLNW..IIPTIDYQPARVRAL--.  239
ZP_01730981    182   .DH......DKL.E.EPY..LHY......LP..R.FSSNYI..IPNAK.EG.D.F.K.H.  241
NP_354963      162   .WS.H.V...GSGA.PSY..L....G...P...Q...INR..MIP.VDYKP..IR.EV.A  221
YP_608942      178   EGN.T.L..DADP.YPQY..LC.......R...E..RINRI.VIE.ADYQ.S..V.AA..  237
YP_001668195   181   .GN.Q.L..VADP.YPSY..LC...A...R...E..RINRI.VIE.ANYQSS..L.AA..  240
YP_001769101   183   .WN.T.V..DGNGV.PSY.DL............E..R.NR..IIP.AAY.P..IR.T.T.  242
YP_001748669   188   EGN.Q.L..VADA.YPRY..LC.......R...E..RVNRI.VIE.ANYQ....V.AA..  247
NP_744505      188   EGN.Q.L..VVDP.YPSYA.LC...A...R...E..RVNRI.VIE.ANYQPS..L.AT..  247
NP_945475      183   .GS.Q.......DD.EPY..LHY..T....P..R.FALSWV.HLP.VGYTP...LAAKS.  242
YP_001268649   181   EGN.Q.L..VADP.YPSYA.LC...A...R...E..RVNRI.VIE.ANYQPS..L.AT..  240
NP_791725      177   EGH.Q.....SAPAMEL.N.LF.......E...E..R.NW..IIP.ANYTP...V.Q.R.  236
YP_569510      183   .GS.H.....K.GD.E.Y..LHY..T....P..R.FSLSWV.HLP.VDYTP...IAAK.L  242
YP_347894      177   EGH.Q.....SDPSMEV.N.LF.......E...E..RTNW..IIPNADYQP...V.K.R.  236
YP_001864851   179   SEA.S.V..VK..D.SPY..LHY..T.......E....CF..FLP.LT.EP.K.V.TE..  238
YP_660007      197   .YN...V...KKPE.NS..KQH..E....K...E..VKNPI..L..VN.KQSM.Y.----  252
YP_236574      177   EGH.Q.....SAPSMEL.N.LF.......E...E..R.NW..IIP.ADYIP...V.Q.R.  236
NP_792460      177   EGH.K.V.Q.LTGP.PSYS.LN..G........E..RLNWI..IP.ATYVP.A.I.T.R.  236
YP_275602      177   EGH.Q.....SAPSMEL.N.LF.......E...E..R.NW..IIP.ADYTP...V.Q.R.  236
ZP_00516991    15    .DH......DKLAE.EPY..LHY......LP..R.FSSNYI..IP.AK.TGID.FSK.H.  74
YP_262277      177   EGH.Q.....T.PTMEV.N.LF.......Q...E..RSNW..IIPNADYQP...L.A.R.  236
ZP_01050418    185   NWN.TI.S.S.E.V.ESW..MHY..T...Q...KSFLKQGV.II..VASQTSAVF.E.DE  244
ZP_01623038    182   .GS.V.....KKKE.ESY..LHY.T....L...K..CQNW...IM.INYKP.DIV.....  241
ZP_01094090    179   GGH.A.VG..AESH.ES...LHY......Q...R..ELNAV..I..IH.PP..I-AAADS  237
YP_235462      182   EGH.Q.V.Q.LTGP.PSYS.LN..G........E..RLNWI.VIP.ATYVP...I.T.R.  241
YP_780275      174   EGH...FS.R.KPE.E.Y..N.Y.S....QM..R..E.TRV.VLV.VEYQP...Q.R.S.  233
YP_001900695   179   .GSLQAL....N.AYDTLV.THLSGAG.TPEL.N..SHNP...V..VDDTP.G.V.P.H.  238
YP_861991      172   EWN.K....EVN..MESW..LQY......K...Q.FLKNRV.AIS.VNYSP.NII.QIS.  231
ZP_02008304    179   .GSLQAL....DVAYDTLV.THWRGDGMAPEL.S..SHNP...V..VDDTP.G.V.P.H.  238
YP_001242244   173   EGH...LS.R..PE.E....N.Y......QI..R..E.NRV..LV.VNYTP...Q.RIS.  232
YP_676783      174   .YN.......KQDK.ES...LHY.HT...V...E..IKN...VIG.VNYKP..I-YTIDD  232
YP_570910      181   .CS...K..S.AS.MES...L.Y.E....K......LANWI.AIP.A.Y.PARIV.MID.  240
YP_001203744   173   EGH...LS.R..PD.E....N.Y......QI..R..E.NRV..LV.VNYTP...Q.RIS.  232
YP_001196150   174   QYN...Y..SCNKD.EP...LHY.HT...V...E..IKNQ...IV.INYQP..IF-TIDD  232
ZP_01061101    173   NWD.I.VS...ASN.EEW..L.Y......Q...K.FL.QGV.II..VKSEP.AIQAFGGK  232
ZP_01884257    174   .GH...V..VKN.E.EP.F.LHY......Q...N..KAN.T.II..VHSED---SRI.TY  230
YP_531190      173   EGH...FS.RC.SD.E.Y..N.Y......QM..R..EQTRV.VLV.VNYQP...Q.R.S.  232
YP_487638      184   .DS......SCAA.IES...L.Y.E....K......LTNWI.AIP.A.Y.PA.IT.AV..  243
YP_001135775   193   EYN...V...K.DD.NS...LHY.ST..........EKNW...IS.VDY.P...V.AVD.  252
YP_001361736   188   QWN......D...D.DT...LHY..........R...LNWM..I..VDYVPS..H.L.D.  247
YP_001196265   175   LYN...F..SC..D.EP...LHY.HT...V...E..IKNQ...IV.INYKP..IFTIDDN  234
YP_715500      187   AWN...V...KLDR.NS.H.LHY..T..........E.SW...IP.VDYRP...V.AV.I  246
ZP_01227360    177   .GA.S.V..D.APH.VS..N.Q...T...K......V.NRI.VIP.VCYEPA.IRAA--E  234
ZP_01728373    121   .WH.K.V..SKITDIESY..LH...E...PLS.H.FSLQP..FIPNVNYKS.KFL.NN..  180
NP_252806      168   .DS...V..S...D.ESY..Q.Y..........R..IQNPI..I..VAYTPMRVF.A...  227
YP_789005      168   .DS...V..S...D.ESY..Q.Y..........R..IQNPI..I..VAYTPMRVF.A...  227
YP_001417343   171   .EA.V.L...KAPEMGS..N.H..GG.V.R......V.NRV.VIP.VAYVPA..R.AATD  230
ZP_00973293    168   .DS...V..S...D.ESY..Q.Y..........R..IQNPI..I..VAYTPMRVF.A...  227
ZP_02055103    346   .WN..A...DMPDWQRPLI.L.................KAKS.FVI.RDCVP...-VADRA  405
YP_001641522   346   .WN..A...DMPDWQRPLI.L.................KAKS.FVI.RDCVP...-VADRA  405
ZP_00967488    168   .DS...V..S...D.ESY..Q.Y..........R..IQNPI..I..VAYTPMRVF.A...  227
YP_570862      174   EGH...FC.RHVP..ESYF.N.Y.S....QM..R..E.IRV.VLV.VNYQP...Q.R.S.  233
YP_001239104   189   .GS.A.....AAPDVES...LHY......K...E..RTNWI.AIP.A.Y.PA.ILSLGDA  248
ZP_01439288    185   .GA.T.V...L.T..ES.R.LNY..A...T......V.NRV.TI..V..EP..VE.A.D.  244
YP_245299      173   EWN.DI.....KPE.E.Y..LHY.............L.NRV.QI..VGYQPS.IQ.TVH.  232
NP_639488      173   EWN.DI.....KPE.E.Y..LHY.............L.NRV.QI..VGYQPS.IQ.TVH.  232
YP_487589      174   EGH...FS.RHVP..ESY.SN.Y.S....QM..R..E.IRV.VLV.VGYEP...Q.R.S.  233
YP_001770032   316   .WN..A.....DPAWRSL..LH..............A.AKS.FVI.RDYVP...--LAG.  374
YP_001238408   170   .GS......VAGP..EP...LHY......R...Q..Q.NW..II..IN..PA..--LST.  227
YP_485786      171   .GH........GCEMDPY..LHY......P...Q..L.QRVGAIV.S.YRP...LTDRTL  230
YP_001346361   168   .DS...V..S..DD.ESY..Q.Y..........R..IQNPI..I..VAYIPMRVL.T...  227
YP_198931      173   EWN.D......QPE.E.Y..LHY.............L.NRV.QI..V.YQPS.IQ.T.H.  232
YP_366123      173   EWN.D......QPE.E.Y..LHY.............L.NRV.QI..V.YQPS.IQ.T.H.  232
NP_355125      170   .GA.K.VS..KQPE.ES...QY.......Q......LKNT..IIS.ASGTRI.VL.AVD-  228
NP_644587      173   EWN.D......QPE.E.Y..LHY.............L.NRV.QI..V.YQPS.IQ.T.H.  232
ZP_01302507    181   GGD...V...L.P.IES.F.LHY......S......L.NIF.II..VQ.QP..VV.A.D.  240
YP_001170431   168   .GH......DL.PD.EPY..L.Y......QI.....L.QRVGSI..SHYEP...--LGH.  225
YP_001204102   170   .GS......TAGS..EP...LHY......R...Q..Q.NW..II..ID..PA..--LST.  227
YP_971319      180   .DS...V..SCIPT.DPYR.R.Y..........R..VVNT...I..VG.PV..----.LQ  235
ZP_01017885    179   .GS...V..SKNAD.DPY.NL.Y......Q......V.NPV.IIS.VHSVP.KIV.ATD-  237
ZP_01157401    177   .DS.T......EPK.EP..HL.Y..........E..R.NTF.II..VDGEVH.IV.E.G.  236
YP_742336      176   .WH.C.V..S.C.HMDSY.S.H.......P.V.Q..DVNPV.SIP.AP..P...V.TED.  235
ZP_00998358    186   .GA...V....ERSMEP...L.Y......Q...Q....N....I..VD.VPS..L.ETD.  245
NP_946341      170   .GS.K..G..K.SD.ES...QH.......Q...L..LKNAI.VIS.S.GISSRIV.E-RD  228
YP_611325      180   .WS..T...SNDGS.PSY..MH..SG...K.V...MEIVPF.FVGRVDDDNIAIRALTSG  239
YP_001749437   170   .GA.K.V.....S..ES...QY.......Q......V.NPV.VI..ANFKT...E...D-  228
YP_192038      179   .G..R.VG.S.NDAFPSLMN.H.......T......L.NRI.VIP.ITYE.A.IR.---.  235
YP_001668821   170   .GA.K.V.....SD.ES.M.QY.......Q......L.NPI.VIS.AQFKT.AIE...D.  229
ZP_01545930    170   .GS...V...KKY.MAP..NL.Y..T...R......LENPI..I..VADDG.VVVEHRRS  229
YP_001523831   171   .GS.K.VS...MPS.ES...QH...G...R...E..LKNII.IVS.SSG.RI.ME.EF.-  229
NP_745504      170   .GA.K.V..SK.SD.ES.M.QY.......Q......L.NPI.VIS.AQFNT.AIN...D.  229
YP_345327      171   .GH......R..QD.EPY..LHY......QI.....L.QRVGAI..ACYRP...LGHPEL  230
YP_001520152   172   .GA...V...MVDE.EPN..L.Y......Q.V.GIALKMPI.AIS.ID.PTA--.LIAAD  229
YP_001267717   170   .GA.K.V..SK.SD.ES.M.QY.......Q......L.NPI.VIS.AQFNT.AIN...D.  229
YP_345384      220   .GH......R..QD.EPY..LHY......QI.....L.QRVGAI..ACYRP...LGHPEL  279
YP_001372987   175   NGA.R.....KSPM.CS.M.QH.......V...R..LINTI.MIS..SYQPIA.C.S.AA  234
ZP_01011420    180   .HS.R..G.C.SD.ETRY..LN.......V......K.A....I..VEDPGSVIR.GVDA  239
ZP_01864718    173   .LS...V..SK.DD.ES.H.L.Y.KT.......E..K.NRF.IIS.VEE.PI.IE.GV.A  232
YP_769292      173   SGS...V...A.A.IGS...LHY......V......L.N.F.II..VD.VP..IL.Q.D-  231
ZP_00208733    173   .WS...V..TL.RPMQSYQ.LH...A...VI..D...LNRQ.YIR.AL.GS..I-LGCD.  231
ZP_01726549    185   .G..K....TKHDD.DSY.DLYY......Q...E..KINWV..VP.VDLPSAR.I.TVED  244
NP_946838      183   .GSAD......GPETSP...L.D.QP..SN.PGSI---SRI.VQP.VH.P.A..W.AHS.  239
YP_745313      188   .GS...V..SL.S.TESC..LHY..T...H...T..E.SW...IG..EDQTC..--LSL.  245
ZP_01041311    173   .ES......EK..D.QSYE.L.Y.RA...Q...E.FR.NRF.II..MEE.P.LIE.T.SI  232
ZP_01748188    179   .KS.K.L..T.SD.GQKY..LM..............K.S....IS.VDD---.GSAICP.  235
ZP_01109672    183   .YS.K.....KA.DMESYKDLY.......K...E..KTNWV...P..ELPPAR.V.SVEE  242
ZP_01884592    175   .WN.S....EKDDR.EKYI.QT.....V.R...Q..LKNPY..IPSRDYQPIR.Y....S  234
YP_677848      172   .WN.H.L...MEP.MESY..IT.......K...E..LKNPY..IP.REYKPSK.Y..I..  231
ZP_01110306    188   AYC....G..CESISRS.K.LK.......K...E..LKNRV.CVF.VEEQPT..Q.SILE  247
ZP_01109728    173   .GS......STSSDMTP...L.Y......R...Q..KKN.I.TIS.VNGETYSIIGKGKE  232
YP_427322      177   NWE......TLNGPVESYK.Q...............S.N...SIP.VHYRPL..--.GRS  234
ZP_00514108    173   .DS.V....NK..DIESY..LHY.YY...NP..QFFSKK...MIPNIHDEPI.IL.RKH.  232
ZP_01043109    175   SWN.R..S.TT..DIEQYI.LS.......S.V....HVNPI.YI..VDTEDAVI-VYAEE  234
ZP_01051640    181   .NS.......VSTSMNS...L....F...PK..E.FLKNPI.YIKN.SDEGSKI--LI.K  238
ZP_01736013    176   NRD......S.SAQMNSY..N....P.....T...NSQN.TWV..NRKC....VHGAPDI  235
ZP_00051672    35    .GC.D.VG.SLADWPQS...L...DT..........RQTAD.WIPTRDYVP...V.AA.D  95
ZP_01446334    179   .QS.K.V..V.KD.QSKYD.LM.......V......K.A....IS.VND---.GS.I.PG  235
YP_561241      4                                                         .TSSLVFV  11
YP_478662      59    EGH.T.V....G.R.PSL..LT...G...EE..R.FRLAQV.VIV.VE.QSRSISQPESW  119
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Query         241   QTNAPTPLGGAVLRATSPMHMQYLRNMgvgsslsvsvvvggQLWGLIACHHQTPYVLPPD  300
NP_285374     241   ............................................................  300
YP_488045     251   V.GG.ID.SYS...SV..I.VE.MV..A.YGAM...I.RE.R...M.S..NTS.RFVAYE  310
YP_569534     251   V.GG.ID.SY....SV..V.VE.MV..A.YGAM...I.RE.R...M.S..NTL.RFV.FE  310
YP_533633     251   V.GG.ID.SF....SV..I.VE.MV..A.YGAM...I.RD.R...M.S..NTL.RFVSYE  310
NP_442237     241   S..RAVD.TESI..SAYHC.LT..K.....A..TI.LIKD.H...........K.I.FE  300
ZP_01628825   241   L.DE.LD.SRS...SV..L.VE.MH....TA.M.I.IMKN.N.........S.KYI.YE  300
NP_486939     241   LNDQ.LD.SRS...SV..L.IE.MQ....TA.M.I.IMKNQK.........S.KYI.YE  300
YP_321522     241   LN.Q.LD.SRS...SV..L.IE.MQ....TA.M.I.IMKNQK.........S.KYI.YE  300
YP_488044     233   S.GQAID.SF....SV..I.LE.M..I.MRGTM...ILR.DK.......NRQ.RYVGH.  292
ZP_01459223   226   ALGR.LD.SNSA..SV..V.LE........A.F.L.LLKE.V.........LE.LHISHE  285
NP_948356     250   RLGG.ID.SFS...SV..T.LE.MV...MHAAM.I.I.RDNR...M.S..NL..RFVSYE  309
YP_569533     233   S.GQAID.TFS...SV..V.LE.M..I.MRGTM...ILR.DR.......NRQ.RYVGH.  292
YP_779569     237   L.GQ.ID.SF.T..SV..I.LE.M..I.MRGTM...ILR.ER....V...NRE.RYVGH.  296
ZP_01623500   242   LIER.LD.THST..SA.SC.L...K.....A..TI.LIQD..........R..KYVSYE  301
YP_324352     241   VSDR.VD.TNSI..SAANC.LE..H.....A..TI.LIKDNK........LSAKYVSYE  300
NP_948355     236   V.GR.ID.SF.I..SV..V.LE.M..I.MHGTM.I.ILR.ER........RK.NYVDL.  295
NP_487197     241   VSDR.VD.TNSI..SAANC.LE..H.....A..TI.LIKDNK........LSAKYVSYE  300
YP_779570     250   V.GG.ID.SFST..SV..T.IE.MV..A.YGAM.I.I.RD.....M.S..NTA.RFV.FE  309
ZP_01630443   241   LSDR.VD.TDSI..SAATC.TE..H.....A..TI.LIKDQK.........V.KYVSYE  300
YP_001894923  244   S.GR..D.TY.S..SV..V.V..MK....TL..M.M.I..R.K.....S...D.AR.P.FE  303
YP_001863766  241   ISDR.IN.TNSI..SAASC.TE..H.....A..TI.LIKDQK.........S.KYVSYE  300
YP_001174646  240   ISGT.LD.SFSA..SV..V.L..M....TLA.M.I.I.IRDR.....S..DAQ.RQVSYQ  299
ZP_01461267   240   GHGE.LD.SFS...SV..I.LE..H....QA.M.I.LMKD.K.....S.TQG.R..-.YE  300
ZP_01730981   242   VNDTALD.THSI..SA..C.LE..H.....A..TI.LIDE.K.........L..KYV.YE  301
NP_354963     222   E.G.VLDMSFSQ..SV..V.LE.M....TAA.M...I..N.A.........A..HSVSLA  281
YP_608942     238   R.GKALDMSF.S..SV..V.L..M....TLA.M.L.I..D.K....LS...DQ.RAVDFQ  297
YP_001668195  241   R.GKALDMSF.A..SV..I.L..M....TLA.M.L.I..D.E....VS...HQ.RPVDLR  300
YP_001769101  243   SSGR.LD.SQSI..SV..V.VE.M....TMA.M...IL.D.A.....S..NKI.RRV.LQ  302
YP_001748669  248   R.GK.LDMSF.A..SV..V.L..M....TMA.M.L.I.........VS...EQ.RPVDLR  307
NP_744505     248   R.GK.LDMSF.A..SV..V.L..M....TLA.M.L.I..D.......S....Q.RPVDLR  307
NP_945475     243   LVTG.VDMSF.S..SV.V.YTG..K....Q.T.VMPL.KE.R......M..AA.RHISHQ  303
YP_001268649  241   R.GKALDMSF....SV..V.L..M....TLA.M.L.I..D.E.....S....Q.RPVDLR  300
NP_791725     237   D.QQQLD.SFST..SV..I.C..MK....L..M...LIQ..K.....S.G.R..LYVSHE  296
YP_569510     243   LVPG.VDMSV.S..SV.V.YTG..K..D.R.T.VMPL.KE.K......M..AA.RHITHE  303
YP_347894     237   D.QT.LD.SF.T..SV..I.C..MK....L..M.I.LLK.DK.....S.GNRQ.LHV.HE  296
YP_001864851  239   T.HQHLD.SYCL..SFDWCCAE.HQ....KAL.VI.LIQEQK.....S......KYISYE  298
YP_660007     253   -NDR.VD.SKVT..SV..I.C.........NA.M.I.I..S.K.........YRSH.V.FE  311
YP_236574     237   D.QQQLD.SFST..SV..I.C..MK....L..M...LIQS.K.....S.GNR..LYVSHE  296
NP_792460     237   A.GQ.LD.SLST..SV..V.CE..K....R..M.I.LLD..E.....T.S.PE.LLVSRE  296
YP_275602     237   D.QQQLD.SFST..SV..I.C..MK....L..M...LIQ..K.....S.G.R..LYVSHE  296
ZP_00516991   75    LNDTALD.THSI..SA..C.LE..H.....A..TI.LIDDRK.........L..KYV.YE  134
YP_262277     237   D.QQALD.SF.T..SV..I.C..MK....L..M.I.LLK.D......S.GNRQ.LLV.HE  296
ZP_01050418   245   .-GQ.LD.THCES..S..I.IE..E..K..AT.TAAI.SN.T.........YSSKFTNYY  303
ZP_01623038   242   LN.Q.LD.SNS...SV..I.VE..Q....AA..CI.LIKDD....M.V...YEAKYVNYE  301
ZP_01094090   238   DAQQ.LD.TFSYF.SV..I.IE..Q....AA.M.I.ILQ..D...M.....YE.RN.TLE  297
YP_235462     242   A.GQ.LD..FST..SV..V.CE..K....R..M.I.LLD..E.....V..G.PE.LRVSRE  301
YP_780275     234   L.GRELDMSLCF..SM..I.L...Q....RAT.V..LM.D.K.....V....YE.RFVHFE  293
YP_001900695  239   S.GRT.D.TY.A...A.DAQRETM.R..AKA..TLALT.R.N......R..A..CS.SFE  298
YP_861991     232   VN.K.LD.TNSK..GV..I.IE..Q.....A..TAALISN.K.....L....N.SKFINYY  291
ZP_02008304   239   S.GRA.D.TY.A...A.EAQRGTM.G..ARA..TLALT.R.S..........A..CS.SFE  298
YP_001242244  233   LNGRDLDMSLSC..SM..I.QK..Q.....AT.VC.LI.S.R.....V....YE.RFV.F.  292
YP_676783     233   SE.QNLD.SCS...SV..I.V...H.I...AT.TI.LIHKKK.....V....YS.KY.HYE  292
YP_570910     241   R.GL.LD.SQS.I.SV..A.RL..AH....VA.M.L.IIQH.R.........SS.RY..YR  300
YP_001203744  233   LNGRDLDMSLSC..SM..I.QK..Q.....AT.VC.LM.S.R.........YE.RFV.F.  292
YP_001196150  233   SKDKNLD.SL.I..S...I.VE..K.....AT.TI.LIHHDR.........YSKKNIS.A  292
ZP_01061101   233   EQDN.ID.SISET..S..I.IE..E..K..A..TAAIISK.T.........YS.KFVNYY  292
ZP_01884257   231   EGKENLD.THSG...V..I.I........D..F.I.LLSK.E........NY..RFIDYK  290
YP_531190     233   L.GRELDMSRCF..SM..I.L...K....RAT.V..LM...K.........YE.RFIHFE  292
YP_487638     244   R.GLRLD.SQS.I.SV..A.RV..AH....VA.M.L.MIQH.R.........SA.RY..YR  303
YP_001135775  253   AVGK.LD.TH.T..SV..I.IE..Q....HA.M.I.LLRH.R.........YA.HLP.FG  313
YP_001361736  248   G.G..LD.SHS...SV..I.VE..K.....A.M.I.LI.E.R.....V....YSGAHR.G.  308
YP_001196265  235   KE.KNLD.SLSI..S...I.VE..K.....AT.TI.LIHHDR.........YSKKNIS.E  294
YP_715500     247   V.GG.LD.SD.W..SV..I.IE..Q.....TA.M.I.LLRD.R.........YSGRHE.GE  307
ZP_01227360   235   AGLSEVD.SDVG..SV..I.IR..Q..A..A.A.I.I.MD.H.....V....DEAKAISLS  294
ZP_01728373   181   I.EEALD.SYCI..GVA.V.LE..Q....IAA.MTI.L.KNN.........NK..KLVSIG  240
NP_252806     228   E..ESFD.SYS...SV..I.CE..T....RA.M.I.I....K.....FS...MS.KLI.YP  287
YP_789005     228   E..ESFD.SYS...SV..I.CE..T....RA.M.I.I....K.....FS...MS.KLI.YP  287
YP_001417343  231   GAGSDLDMSDLG..SV..I.V...K.....A.A...I.KD.......V.....R.ARL..YE  293
ZP_00973293   228   E..ESFD.SYS...SV..I.CE..T....RA.M.I.I....K.....FS...MS.KLI.YP  287
ZP_02055103   406   AG...ID.TF.QN.TL..I.LE.Q..L..DG.M.I.IM.ENR.....MIG..RR.HYVA.E  465
YP_001641522  406   AG...VD.TF.QN.TL..I.LE.Q..L..DG.M.I.IM.ENR.....MIG..RR.HYVA.E  465
ZP_00967488   228   E..ESFD.SYS...SV..I.CE..T....RA.M.I.I....K.....FS...MS.KLI.YP  287
YP_570862     234   F.GQDLDMSSCF..SM..I.L...K....RAT.V..L....K.........YQ.RFIHFE  293
YP_001239104  249   PPA.ALD.SQST..SV..I.R...A....VA.M.M.IIMR.R.........RE.RY..YG  308
ZP_01439288   245   -SGE.LD.SMST..SV..I.IE..Q....DA.Y.I.I.ID.K.....F.L..YK.RR.SME  303
YP_245299     233   .LGT.VD.SDVS..SV..V.LE..A....TAT.VA.I..NDA.....S...YS.HFTNHA  292
NP_639488     233   .LGT.VD.SDVS..SV..V.LE..A....TAT.VA.I..NDA.....S...YS.HFTNHA  292
YP_487589     234   L.GRDLDMSSCF..SM..I.L...K....RAT.V..L....K.....V....YQ.RFIHFE  293
YP_001770032  375   DAPG.ID.TF.QS.SL..I.LE.Q..L..NG.M...ILLE.R.....MIG..RK.HYVA.E  434
YP_001238408  228   VH..GLD.SMS....V..I.IE........AA.M...ILRD.K.....F....YA.HH.SFE  288
YP_485786     231   DHGT.LD.TCST..SV..Y.LA.MQ..QTAA..TIGLAE.PE...MLV...R..RNPG.E  290
YP_001346361  228   ESGGSFD.SYS...SV..I.CE..T....RA.M.I.I....K.....FS...MS.KLI.YP  287
YP_198931     233   RLGT.VD.SDVS..SV..V.LE..A....SAT.VS.I..NDA.....S...YS.HFTSHA  292
YP_366123     233   RLGT.VD.SDVS..SV..V.LE..A....SAT.VS.I..NDA.....S...YS.HFTSHA  292
NP_355125     229   VSGE.LD.SY.H..SV..I.CE........AA.M.I..I.D.A.........YS.R..SMP  288
NP_644587     233   RLGT.VD.SDVS..SV..V.LE..A....SAT.VS.I..NDA.....S...YS.HFTSHA  292
ZP_01302507   241   H-G.ALDMSLCLT..V..I.IE..H.....A...I.II...K.....F....YE.RLPTFA  299
YP_001170431  226   GID.-LD.THSA..SV..I.LE.M...HTAA..TIGLAD.DR...MLV..NM..RTAG.E  284
YP_001204102  228   AH...LD.SMS....V..V.IE........A.M...ILRD.K.....F....YS.RH.SFE  288
YP_971319     236   REAG.LD.SASI..SV..I.IE..S....AA.M...I.IN......L....MQ.RQV.YS  295
ZP_01017885   238   ENE..LD.SLST..SV..I.IE........AA.M.L.ITYQ.K.........YR.M..SFE  297
ZP_01157401   237   D-GR.LD.SF..T..V..I.LE........RA......ILRR.K.....F....GE.FYVDYE  295
YP_742336     236   LDQH.LD.SAG....V..I.QA..H.....K.A...AIRDDAE.....L...G.EARS...T  296
ZP_00998358   246   TGEK.-D.SL..T..V..I.LE........A.M....LLRR.K.....M....MS.HYIDFE  304
NP_946341     229   ASG.ALD.SF.H..SV..I.LE........SA.M.L.IIID.T.........YE.RAV.MA  288
YP_611325     240   A--GDID.TW.MN.SV.A..TA....I.A...F.C.LMDK.K.........SGGSM.V.A.  297
YP_001749437  229   LSGE.LD.SY.H..SV..I.CE..N.....A.M.I..I.D.A.........YA.RT.SMG  288
YP_192038     236   EAG.GLD.SDVQ..SV..I.L..MA...TRA.A...L..D.V.........NA..RC.SE.  296
YP_001668821  230   -SGE.LD.SY.H..SV..I.CE..C.....A.M.I..I.N.E...M.....YA.RT.AMG  288
ZP_01545930   230   E.GV.ID.S.SR..SV..I.LE.........A.M.I..I.N.E.........N.AL.PSMR  289
YP_001523831  230   ASGE.LD.SF.H..SV..I.CE.......SA.M.L.I.I............YS.R..SMA  289
NP_745504     230   -SGE.LD.SY.H..SV..I.CE..C.....A.M.I..I.N.E...M.....YA.RT.AMG  288
YP_345327     231   DDGK.LD.THSS..SV..I.LD.MQ..HTAA..TIGLAD.DR...MLV..NT..RIAG.E  290
YP_001520152  230   P.AD.LD.TLTHV..V..I.LE..A....Q..MN.AII.HRE....F.F..NSVKL....  289
YP_001267717  230   -SGE.LD.SY.H..SV..I.CE..C.....A.M.I..I.N.E...M.....YA.RT.AMG  288
YP_345384     280   DDGK.LD.THSS..SV..V.LD.MQ..NTAA..TIGLAD.DR...MLV..NT..RIAG.E  339
YP_001372987  235   DEP.-VDMSF.Q..SV..I.C...Q....SA...I.I..D.A.....S...DS.K.T.LP  293
ZP_01011420   240   E-GK.ID.SL..T..V..I.IE..H...IEA.M...IMKD.E.....F....NS.RYIDYE  298
ZP_01864718   233   E-GE.ID.SMST...V..I.IE..H.....A...I.III..E.....F....YG.K...YS  291
YP_769292     232   EHGR.LD.SMSI..SV..I.IE..K.....A...I.I..D.R.....F....YG.RLPSAQ  291
ZP_00208733   232   ADG..DQTF.D-..SV...LT..G....RA.F.A.ILMR.K.........PE.KP.SL.  290
ZP_01726549   245   SDRE.LD.THSI..SL..I.Q..V..Q.LKA.M.F.L.THN....M.S..SRE.RYIEQN  304
NP_946838     240   RNGLALD.SFSAT.SA..E.RL..AQL..AA...L.L..E.E.....V...A..RF..YR  299
YP_745313     246   EQTE.LDMSLST...V..V.V........VA.A.I.ILRS..........AMR.LW.AA.  305
ZP_01041311   233   K-.E.LD.SMST...H.Q..V..MK....KA..AIAI.RH.E...M.S...YE.RLPAYS  291
ZP_01748188   236   ..GT.VD.SLS.T..V..I.IE..K....SA.M...IMKD.E.....F....HS.CYIDYE  297
ZP_01109672   243   SGRKRLD.TRSL..TF..I.L..I..Q.LRA.F.I.L.TD.K.Y...S....REACYI.Q.  302
ZP_01884592   235   I..SFID.SDCN..GVVAV.LE.MK..NIKA.M.FR.IRN.......S...IEEKY.DYE  294
YP_677848     232   ASSGFVD..VCN..GVIKV.LE..T..N.K..M.TRILKDNT.........REKKF.NF.  291
ZP_01110306   248   AERP.LD.SMSMV.SV..V.IE..K...IR..F...L.FE.K.....L...NSE.KYIDQK  307
ZP_01109728   233   D.DT-ID.SLSR...V.EV.I...K..K..A.M.I.LI.E.E.........NCKK.I.GR  291
YP_427322     235   PDGRELDMTFCN..SV..V.LE........AA.F...L..D.R.....V...DRV.RR.SLA  294
ZP_00514108   233   LKKKKLD.QN.F..SIA.C.IE..K....TA.FNI.LLKENK.........YS.KYVIYE  292
ZP_01043109   235   LGSMALD.SLGTI.GK..I.TE.MK...LQR.M..AIFDQN.....VS..GVSAQP.SYS  294
ZP_01051640   239   KNEDKLN.TYSF...AA.V.N.........Q..MTIPIIINNK....F.H..N.IKE.S.Q  298
ZP_01736013   236   G.DQ.LDMTYSAY.SLPLV.LE..G....AAA.TI.LTQN.R...MLT...N..KNVTLR  295
ZP_00051672   96    R-DR.IS.ALSRY.SV..I.RM.QG.I..DG.M.I..MRD.E.....IG..RK.HRV.VA  154
ZP_01446334   236   T.GQ.LD.SL..T.SV..I                                           256
YP_561241     12    NN.IELD.TWSQ...VH.V.I...K.LA.EA.F...L.CN......L...NM.AKY.SFE  71
YP_478662     120   GLS.RV...EPLQ.PVD.C.VH..KS...A...V.PLMHHQE....LVS..AE.RPYSQE  179
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Query          301   LRTTLEYLGRLLSLQVQVKEAADVAAFRQSLREHHARVALAAAHSLSPHDTLSDPALDLL  360
NP_285374      301   ............................................................  360
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ZP_01459223    286   R.RAC.V.TQ..A..LSAE.R.AE.SEDAHRAALLGQL.T.MGEGGTLEEV.EKESERV.  345
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YP_569533      293   A.QAC.MVAQV.AW..G.M.--EQ..T..T.KKAIQ.SLISDIEQ.HD.RA.IRNSEA..  352
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YP_347894      297   ...ACQTI.QV....ISAM..LE.SRQ.EEKL.AL.LLNQ.MID.QNVF.G.ANQPQV.M  357
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YP_236574      297   ..SACQAI.QV....ISAM..LEISRQ.EAKVRALEQLN..M.G.ENVF.G.AQQPQL.M  357
NP_792460      297   ..DACAMI.Q...-----.IS.I..THI.RE..EKVVLQ..D.MNRAD.EI..R.Q.-.Q  357
YP_275602      297   ..SACQAI.QV....ISAM..LEISRQ.EAKVRALEQLHQ.M.E.ENVF.G.AQQPQL.M  357
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YP_001900695   299   V..AC.H.AQI....IEA..DRAEI.H.LE..RILV.LLA.M.DRDHF.EG.LEHPA...  358
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ZP_02008304    299   V..AC.H.AQI....IEA..DRAEI.H.LE..RILV.LLA.MSDRDHFE.G.IEHPA...  358
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YP_570910      301   M.EAC.LFAEMA.S.LEA.V..EQLEA.LRSTRI.EELVTRMSQESDLAEG.IRFHPN..  360
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YP_001641522   466   T.AAATV.TDAFAMR..EI.GKALWGE..RHLDVQG.LVRGLTR.DDFVTS.TQGDPT..  525
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YP_001239104   309   ..EAC.LFAEMV.SHLEARL..E----SFE.QKRS.KIHEELLNR..RESE.AAGLVN..  368
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YP_245299      293   M.DVTDAVA.T.AGRIGALQ.VAR.RLESV.LT--V.EK.ITDFNDAE.M..D.M.P..M  353
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YP_487589      294   ..AVC.L.AEAIATRITAL.SFAQSQSELFVQRLEQ.MIE.ISREGDWRAAIF.TTQSI.  353
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YP_001238408   289   K..AA.LF.QMY.WLLEAR.RETDI.Y--ET.A..IQER.IERAAAQA.SAIL.FVA.YR  348
YP_485786      291   ..AAADI..QFV.TLLGPLGE.EA.RK.VERNATMM.L.EQF.SAPTMLEAFAATESE..  350
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NP_355125      289   V.IAA.MF.EFF.MHL..LKQK-----.RLDTIN..HA..L...HANIEEL.V.SFQ.FA  348
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YP_001204102   289   K..AA.LF.QMY.WLLEAR.RETDV.YESRAHQIQE.LIER..TQAHSKRAILEFVGEYR  348
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ZP_01157401    296   ...AV.LF.Q.F.YELARL.TDAEL.DVEKA.RL.DNLMSQVSGGMDLLQSFDRV.DEID  355
YP_742336      297   ..DAVLA.VQVAQSRLMLLN.QRN.RYQRRV.ACR..LV.RRPRATRLSELVA.HGA.W.  357
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YP_001749437   289   Q.VAA.MF.EFF..HI.TLQ.-------.T.EAA...QV.HD..RTTDI.E.LRAR..FQ  348
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ZP_01545930    290   Y.NCALLF.QM...VL.SRF..EEKSKDARVA.LTTE.SR.LSTEV.SPEL.RSS.EAFG  349
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YP_345327      291   W.A.AGMI.QVV..LLE.EN..ETL.RQST.STLVE.--.S.GDT.AAAFVAA.QL--I.  350
YP_001520152   290   Y.SICDLF.Q.F..KF.LVLEEERFNN.KHIISAISQITQKLTS.G.FTL.IQTLGPQ.C  349
YP_001267717   289   Q.VAA.MF.EFF..HIETLRSRQ--KLEAAV.I.K.LDS.LR.NQAADI.GFFHAR.P.M  348
YP_345384      340   W.AAAGMI.QVV..LLE.EN..ETL.RQST.S--------TLVER..TG...AAA.A.I.  399
YP_001372987   294   ..IGA.LF.QYF..HIADC.RRKTLQLTADA..KLDAIVSQLSI.DEIRES.GAQLSRFS  353
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ZP_01864718    292   Q..SA.LFSE.F..ILERSLFREREEL.E.G.KV.D.LMI..GTP..ESLP.LT.VIQ--  351
YP_769292      292   S.S.A.LF.QMFASRLESR.RRLALDYETKA.RIAD.LLTSV.DNA.---L.D...WA.A  351
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ZP_01726549    305   V.LEC.S.CQ.F.WHLYA..EEIYFEKQ.N.ERAINQMLEKTSLDN.AVKVFQENEAEV.  364
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ZP_01041311    292   ...VADMFSQMF..MIDIDRSEELRSRGRA.HD-QLM.R..GGAK..E.LPMLEEL.N--  351
ZP_01748188    298   R..AF.MFAHMF.YELTRF.DGQRKIAEVNTNRLQS.LMTHMVDGQELAES.LAVSD.IQ  357
ZP_01109672    303   V.LQC.N.SQ.F.WHLLA..-EEI.KQKKFVTDEAVDAM.DKIGPAN.SRVVKSGERAF.  362
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ZP_00514108    293   I.KIC.L..EIF..KLMYE.EKSFRQY..TIK.IKK.IKEELSKNKNK..FIDN       346
ZP_01043109    295   T.LNIHS.VK.AEQRLMLQKQFEADR.FDRVE.SRKALLDRKREIK..QQL.E.QGHFW.  354
ZP_01051640    299   ETYSADI..QTINMVLEHQTRSKAQKTIKDIL.NGNELVAINSN.FKLDKFWEAQ.EN.F  358
ZP_01736013    296   E.ELY.FI..TI.IKL                                             311
ZP_00051672    155   IQHLIVA...AF..RL                                             170
YP_561241      72    T.QLC.E.SQIT..HMSGLLR.EIDFQ.YHYKVEF.EIRG.MQS.IDAFKAIKSQISEIK  131
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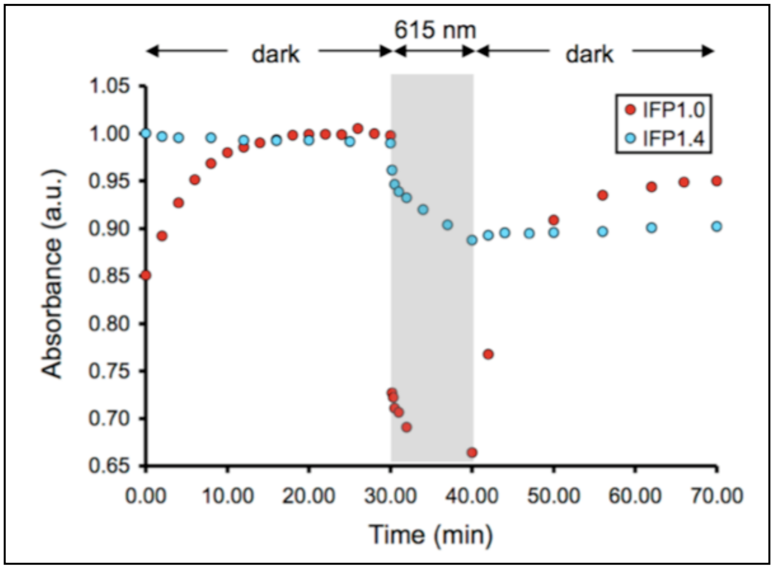

Fig. S1 Dark and light adapted behavior of IFP1.0 and IFP1.4. Absorbance spectra at different time points were taken in the dark (0 – 30 min.), upon 615 nm light illumination by solar simulator (30 – 40 min.), and then in the dark again (40 – 70 min.).

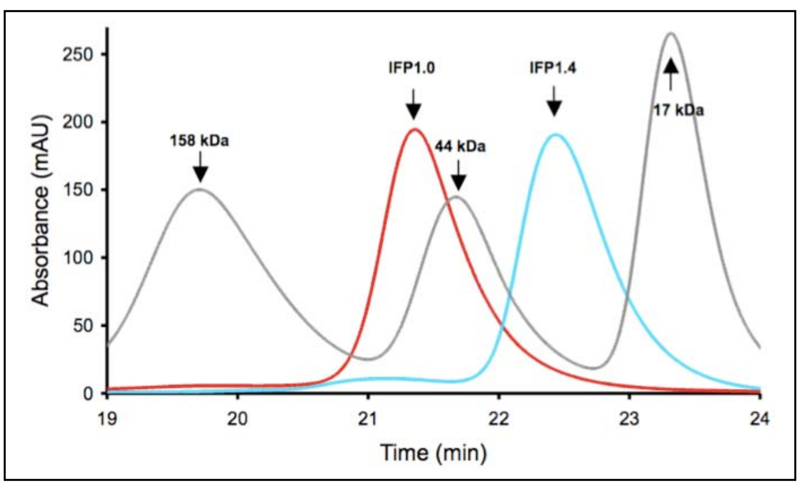

Fig. S2 Size exclusion chromatography of IFP1.0 and1.4. Three standards are also shown: γ-globulin (158 kDa), ovalbumin (44 kDa) and myoglobin (17 kDa). Absorbance was measured at 280 nm.

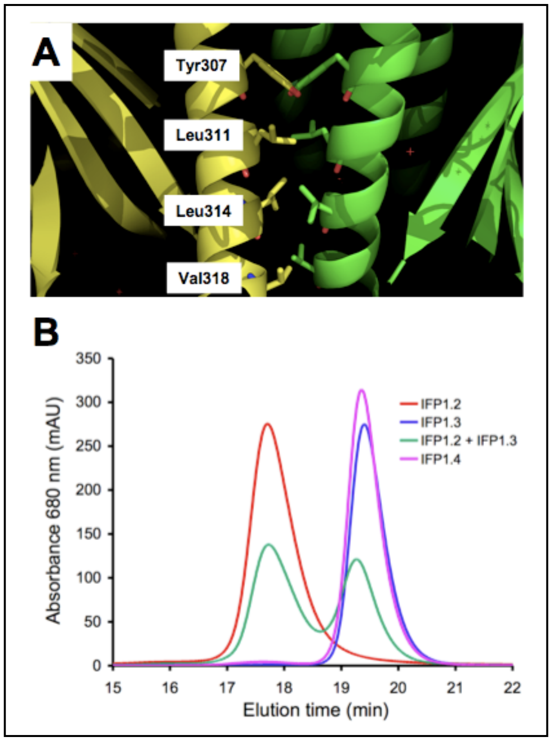

Fig. S3 IFP monomerization by L311K mutation. (**A**) The dimer interface in DrCBD is formed from 4 residues (Y307/L311/L314/V318). (**B**) Size exclusion chromatography of IFP1.2, 1.3, 1.4 and a mixture of IFP1.2 and 1.3.

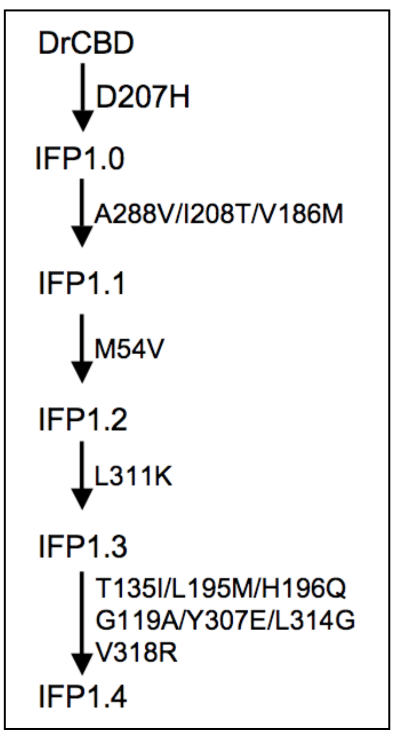

Fig. S4 Evolution of IFPs showing the mutations introduced at each stage.

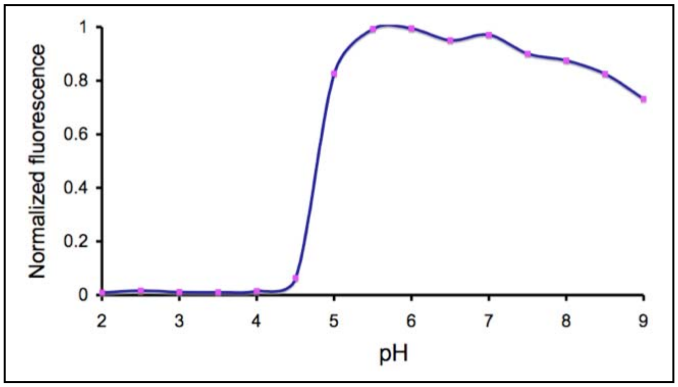

Fig. S5 pH dependence of IFP1.4 fluorescence. IFP1.4 was excited at 640 nm and its emission at 700 - 800 nm was integrated, normalized and plotted against pH.

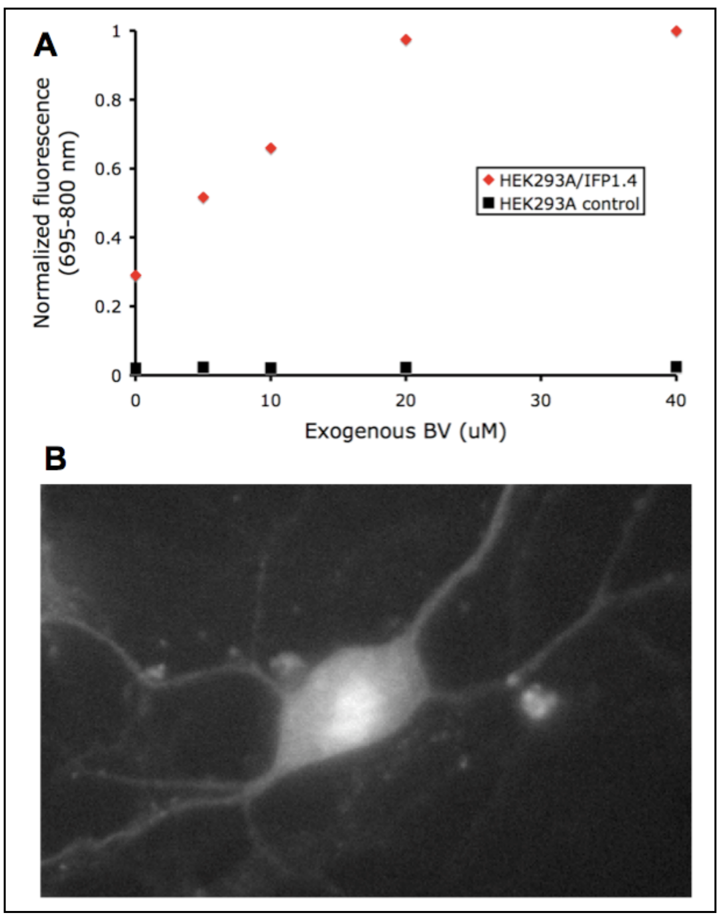

Fig. S6 Increase of IFP fluorescence by addition of exogenous BV. (**A**) IFP1.4-transfected HEK293A cells indicated increase of fluorescence upon addtion of exogenous BV, with untransfected cells as the control. IFP fluorescence was integrated from 695 to 800 nm upon excitation at 660 nm. (**B**) Fluorescence image of a P2 cultured cortical neuron 2 weeks after transfection of IFP1.1, 10 minutes after addition of 25 uM BV.

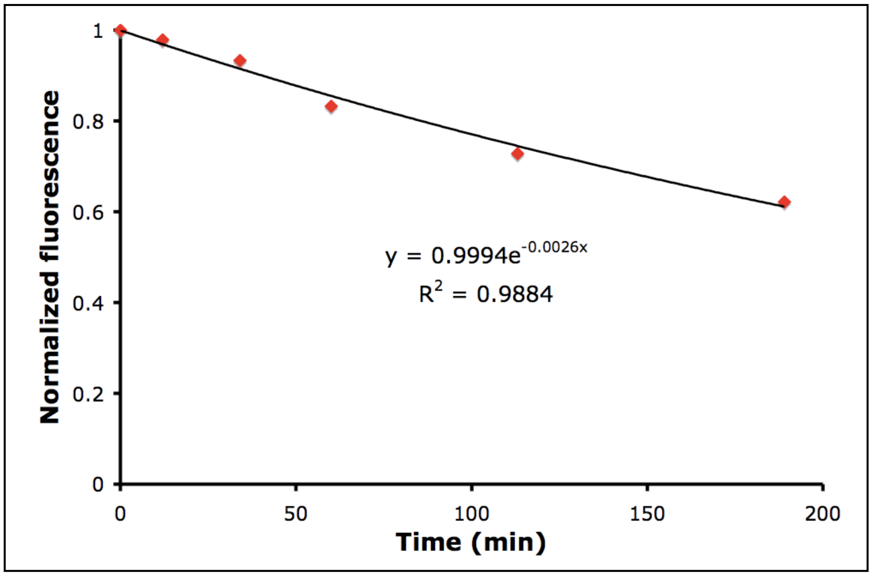

Fig. S7 IFP1.4 degradation in HEK293A cells with 20 μM BV added.

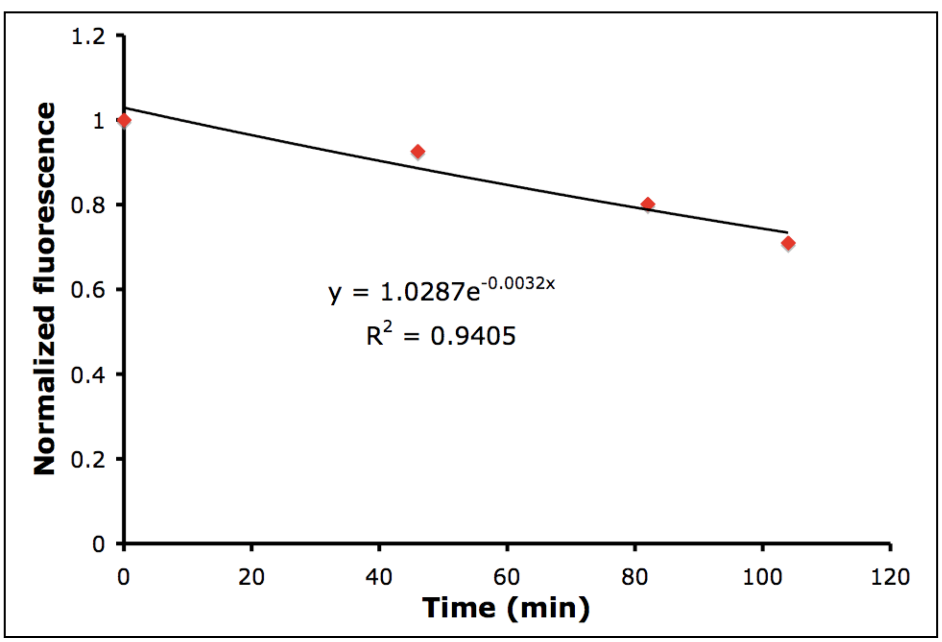

Fig. S8 IFP1.4 degradation in HEK293A cells without exogenous BV.

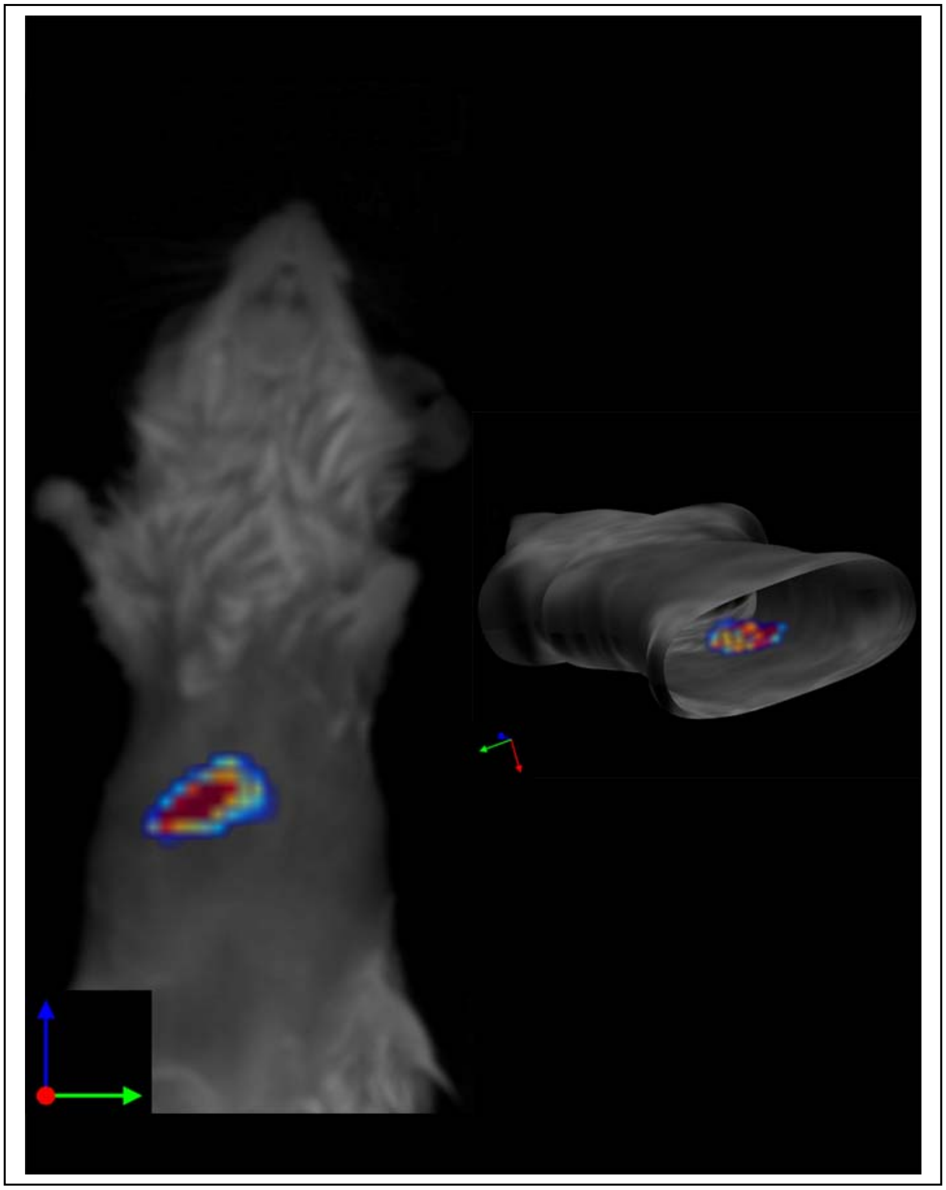

Fig. S9 Noninvasive fluorescence molecular tomographic (FMT) imaging of IFP-expressing mouse liver. Blue, green, and red arrows indicate rostral-caudal, left-right, and dorsoventral axes, respectively. Left: top view. Right: tilted view to show the 3D localization of fluorescence within the mouse.

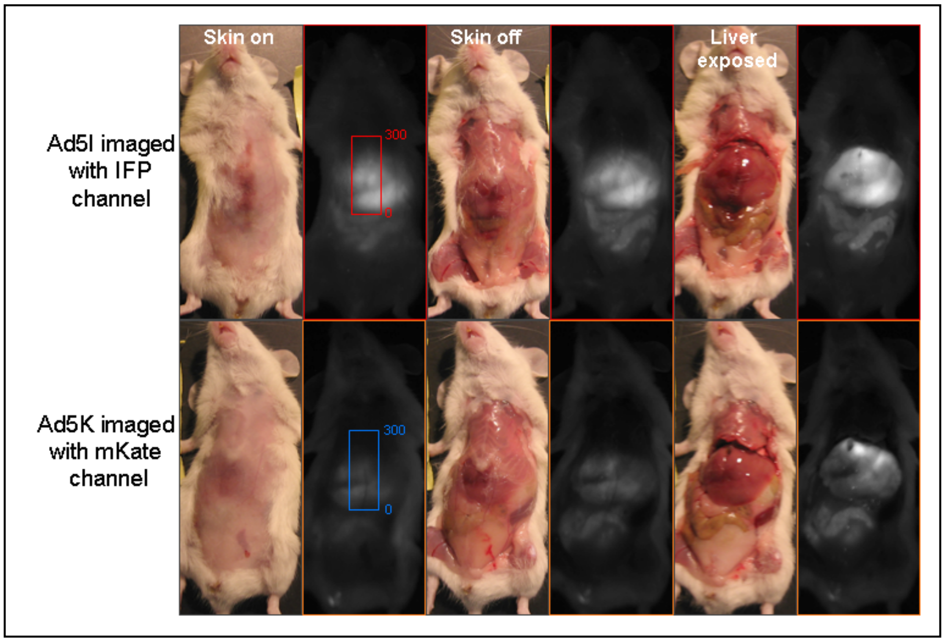

Fig. S10 IFP/mKate fluorescence images before dissection (skin on), after removal of skin (skin off), and after removal of overlying peritoneum and ribcage (liver exposed). mKate images were 2.5X brightened relative to IFP images. Note that Ad5I infected mouse was imaged after 250 nmol IV injection of BV.

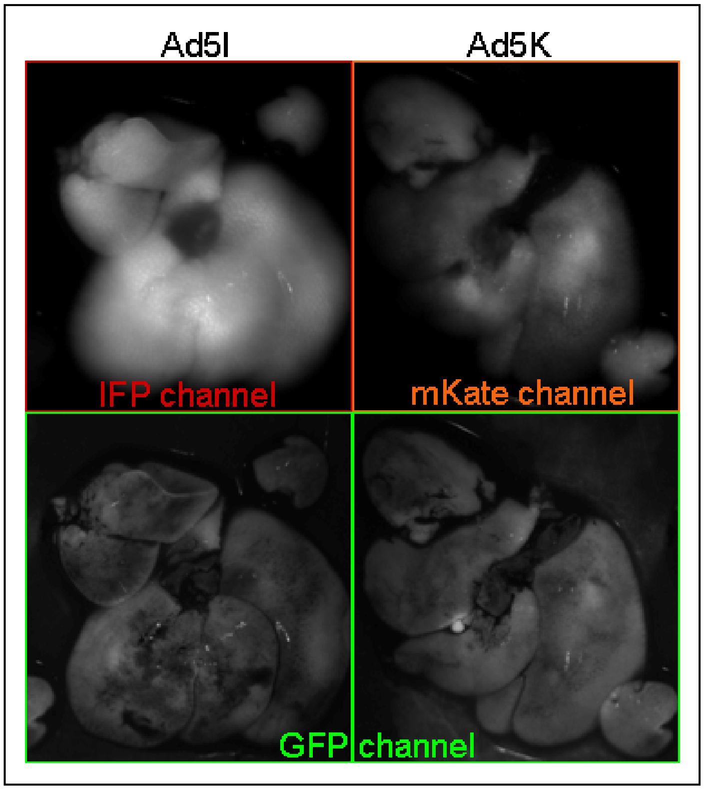

Fig. S11 Imaging of extracted livers infected with Ad5I and Ad5K.

Table S1 Properties of infrared fluorescent protein variants.

Fluorescent Protein	Absorption max. (nm)	Extinct. coeff. (M^{-1} cm^{-1})	Emission max. (nm)	Quantum yield	Relative brightness (%)	Stoichiometry
IFP1.0	699	60,000	722	0.028	100	Dimer
IFP1.1	686	86,000	713	0.050	256	Dimer
IFP1.2	684	86,000	707	0.066	338	Dimer
IFP1.3	684	84,000	707	0.061	305	Monomer
IFP1.4	684	92,000	708	0.070	383	Monomer

Supporting References

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