

Using Apollo at the i5k Workspace@NAL

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Agenda

- Manual annotation general overview
- 15k Workspace tools for manual annotation
 - BLAST, Clustal, HMMER
 - Apollo2
- Manual annotation example: preparation
- Manual annotation live example

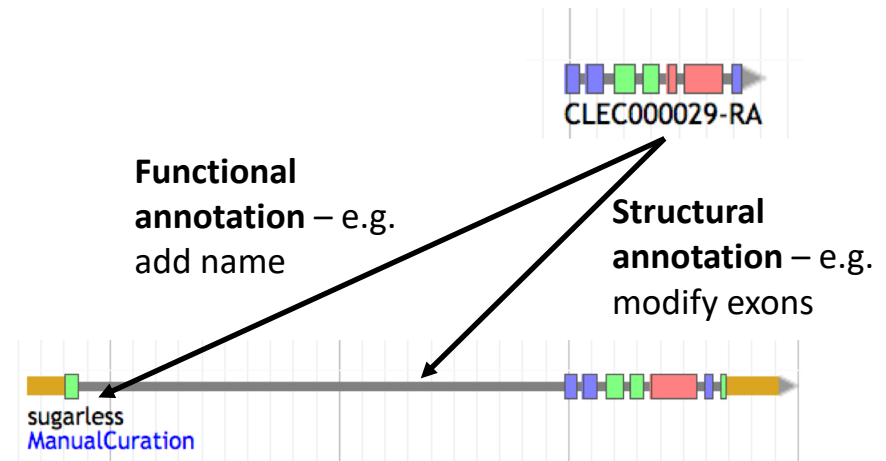
Other resources

- Monica Munoz-Torres from the Apollo group has a number of comprehensive tutorials:
 - <https://www.slideshare.net/MonicaMunozTorres/presentations>
 - I recommend these slides if you need more background:
 - <https://www.slideshare.net/MonicaMunozTorres/apollo-workshop-at-ksu-2015>
 - Note - there are two versions of Apollo. Some organisms at the i5k Workspace still use the older version with a slightly different interface
 - If you are new to Apollo, or need a refresher, I **highly recommend** that you review one of her presentations
- The official Apollo annotation guide:
 - <http://genomearchitect.org/users-guide/>
- Other manual curation tutorials:
 - <https://i5k.nal.usda.gov/manual-curation-example>
 - <http://genomecuration.github.io/genometrain/d-feature-curation-crossing/>

Manual annotation general overview

What is manual annotation?

- Manual review and improvement of an existing gene prediction
- Draw on external evidence (e.g. RNA-Seq, cDNA, genes from other species) to improve a computationally predicted gene model



Why manually annotate?

- “Incorrect annotations poison every experiment that makes use of them ... Worse still, the poison spreads because incorrect annotations from one organism are often unknowingly used by other projects to help annotate their own genomes.”
 - Yandell and Ence 2012, doi:10.1038/nrg3174
- Link gene models to existing literature and ontologies, providing richer data

General process of manual annotation

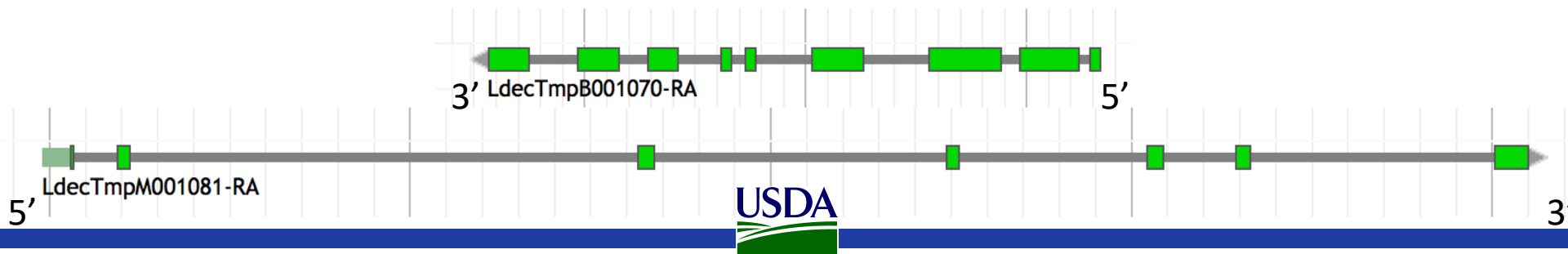
1. Select a chromosomal region of interest (e.g. scaffold)
 1. E.g. find sequence of interest from one or several other species, and align against proteins or genome sequence from your species
2. Select appropriate evidence (tracks in Apollo, or your own files)
3. Determine whether a feature in your evidence provides a reasonable starting gene model
 1. If yes: select and drag the feature to the 'user-created annotations' area, creating an initial gene model. If necessary use editing functions to adjust the model.
 2. If not – get in touch with us!
4. Edit model if necessary
5. Check your edited gene model for integrity and accuracy by comparing it with available homologs
 1. Verify that the gene model is the best representation of the underlying biology
6. Repeat steps 1 through 5 as needed to refine model
7. Add annotation details in the “Information Editor”
 1. Name, symbol, other comments

Adapted from <https://www.slideshare.net/MonicaMunozTorres/apollo-workshop-at-ksu-2015>

Manual annotation: i5k Workspace tools

First, some conventions

- HSP – High scoring pair in BLAST/BLAT alignments
 - The ‘Hits’ in an alignment result set
 - A subsection of a pair of sequences with sufficient score
 - HSPs can change based on the alignment parameters
- Five prime end and three prime end
 - Based on direction of transcription
 - Initiation site is at the five prime end
 - Stop codon is at the three prime end
- In the genome browser, arrowheads indicate direction



JBrowse and Apollo2

The screenshot displays the JBrowse web interface for the *Onthophagus taurus* genome. The top menu bar includes 'File', 'View', 'Tools', and 'Help'. The main view shows a genomic track for 'Scaffold5' with a scale from 0 to 4,500,000. A specific region is zoomed in, showing a track for 'OtauTmpM000192-RA-00001' and 'OtauTmpM000192-RA'. A red box highlights a region on the scaffold. Below the scaffold, there are tracks for 'Gaps in assembly', 'OTAU_v0.5.3-Models', 'O. taurus embryonic reads', and 'O. taurus embryonic junctions'. On the right side, the 'Apollo2 Track selector' is visible, showing a list of tracks including '0. Reference Assembly', 'BCM_v0.5.3/1. Gene Sets/Primary Gene Sets: Protein Coding', 'BCM_v0.5.3/2. Evidence/Repeats', 'BCM_v0.5.3/3. Mapped Proteins/Other', 'BCM_v0.5.3/3. Mapped Proteins/Protein2genome', and 'BCM_v0.5.3/3. Mapped Proteins/Supplementary: BlastX'. A 'Log out' button is located at the bottom right of the Apollo2 interface.

File: Add your own files

View: Change coloring scheme

Tools: Search using BLAT

Locate where you are on the scaffold

Search for a gene or location

Apollo2 Track selector

Revert to 'old' track selector

Zoom in/out

User-created annotations track

Find information about tracks

Log out

JBrowse is a web- based genome browser

- Visualize features that are mapped to a genome
- These features are displayed as tracks
- Many different types of data may be displayed

Apollo adds editing functions to JBrowse

- Manual gene curation
- Changes automatically saved back to server
- Edits are visible to other annotators in real-time
- Editing history is tracked

Apollo2 – Annotations Panel

The screenshot displays the Apollo2 web interface for genome annotation. The main panel shows a genomic track for *Onthophagus taurus* with various annotations including gaps in assembly, OTAU models, embryonic reads, and junctions. A specific annotation, 'test mRNA', is highlighted. The right-hand panel provides a detailed view of this annotation, including its name, description, location, reference sequence, and owner. Below this, the 'Coding' panel shows a table of exons and CDS regions with their start and end coordinates and lengths. To the right of the table are controls for modifying the annotation's features, such as the 5' End, 3' End, and Strand.

Annotations panel

Filter annotations

View annotation overview

Click on arrow to jump to annotation

View functional annotation details

Can modify individual features via 'Coding' Panel

Type	Start	Length
exon	2,817,179	677
exon	2,806,566	226
exon	2,832,890	2,052
CDS	2,806,608	27,094
exon	2,824,806	152
exon	2,832,682	150
exon	2,830,616	128

Apollo2 – Ref Sequence Panel

The screenshot displays the Apollo2 Ref Sequence Panel. The main panel shows a genomic track for *Onthophagus taurus* with various annotations including user-created annotations, gaps in assembly, and embryonic reads. The right-hand panel, titled 'Ref Sequences', contains a search bar, length filters, and an export section. Below these is a table of sequences.

Annotations:

- User-created Annotations: Scaffold1:451216..464455 (13.24 Kb)
- Gaps in assembly
- OTAU_v0.5.3-Models: OtatmpM001261-RA, OtatmpA001262-RA
- O. taurus embryonic reads
- O. taurus embryonic junctions: JUNC00000282, JUNC00000286, JUNC00000280, JUNC00000284, JUNC00000290

Ref Sequences Panel:

- Search: Scaffold5
- Length: 1,000,000 to 2,000,000
- Export: GFF3 (selected), FASTA
- Selection: Scaffold5, All, Selected (1)

Sequence List Table:

Name	Length	Annotations
Scaffold5	4,952,630	1
Scaffold54	1,151,439	0
Scaffold527	1,104,991	0
Scaffold540	986,169	0
Scaffold58	897,936	0
Scaffold584	779,470	0
Scaffold500	685,874	0
Scaffold56	465,482	0
Scaffold52	406,915	0

Export Dialog:

Export 1 sequence(s) from Onthophagus taurus as GFF3

Options: GFF3, GFF3 with FASTA

Buttons: Export, Cancel

i5k Workspace BLAST: one way to access Apollo

The screenshot shows the i5k Workspace BLAST interface. At the top is a navigation bar with the i5k@NAL logo and links for Tools, About Us, and Contact. The main content area is divided into sections: BLAST Databases, Query Sequence, and Program. The BLAST Databases section has a sub-section for Organisms with a list of species, where *Eurytemora affinis* is selected. To the right of this list, under the heading *Eurytemora affinis*, there are three options: Nucleotide, Genome Assembly - Eaff_11172013.genome_new_ids.fa (which is selected), and Transcript - EAFF_new_ids.fna. Below these is a Peptide section with the option Protein - EAFF_new_ids.faa. The Query Sequence section shows a text box with a peptide sequence: >FBpp0070332 MDNCDQDASFRLSHIKEEVKPDISQLNDSNN SSFSPKAESPVPFMQAMSMVHVLPGSNSASS NNNNSAGDAQMAQAPNSAG GSAAAQVQQYPPNHPLSGSKHLCSICGDRA SGKHYGVVSCGCKGFFKRTVRKDLTYACRE. Below the text box is a 'Browse...' button and the text 'No file selected.' The Program section has radio buttons for tblastn (selected), otblastn, otblastx, oblastp, and oblastx, followed by 'Reset' and 'Search' buttons. At the bottom, it says 'tblastn - Peptide vs. Translated Nucleotide'. Annotations with arrows point to these key features: 'Select organism' points to the organism list; 'Paste or upload query sequence(s)' points to the query sequence text box; 'Program is automatically selected' points to the tblastn radio button; 'Select organism-specific database' points to the selected genome assembly database; and 'BLAST against the genome assembly to view HSPs in Jbrowse' points to the selected genome assembly database.

Select organism

Paste or upload query sequence(s)

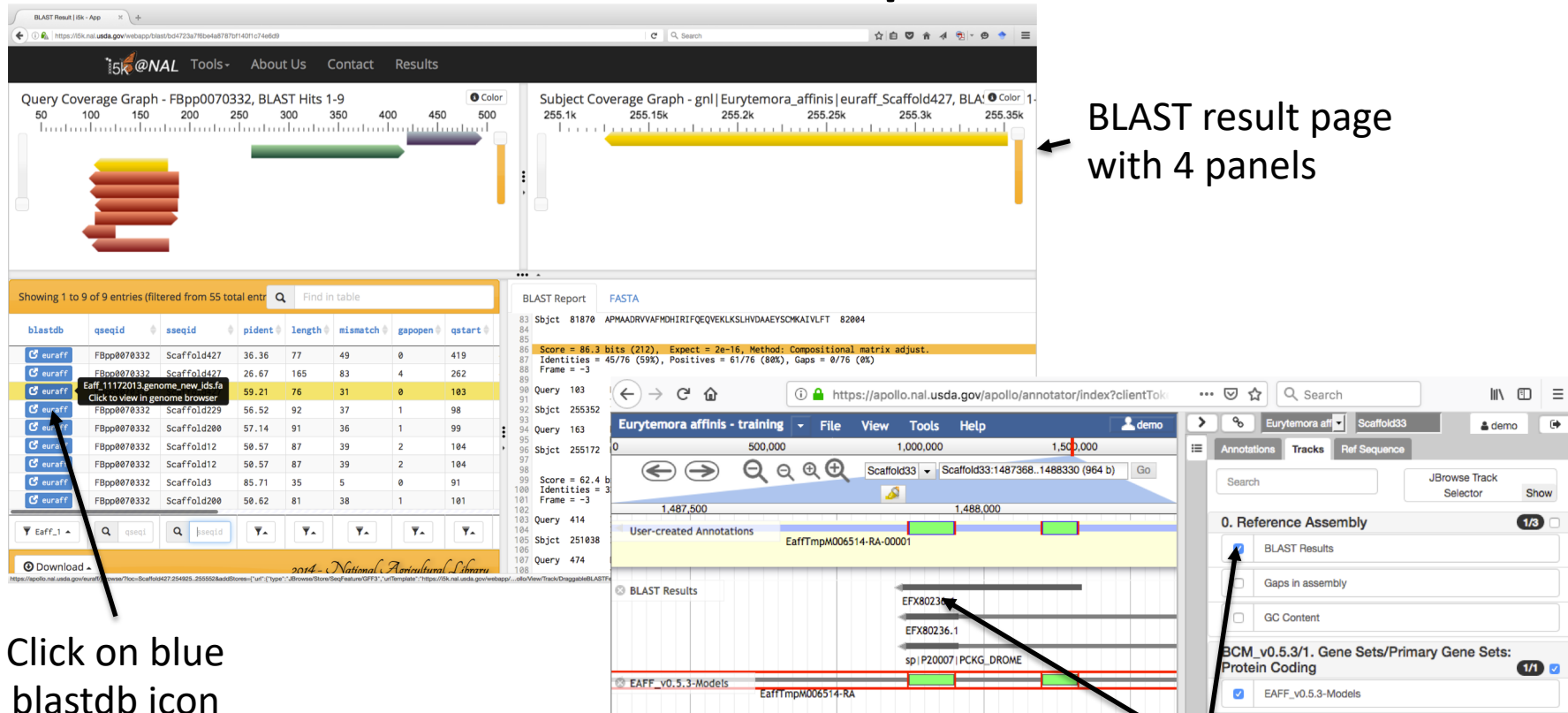
Program is automatically selected

Select organism-specific database

BLAST against the genome assembly to view HSPs in Jbrowse

URL: <https://i5k.nal.usda.gov/webapp/blast/>

i5k Workspace BLAST: one way to access Apollo



Click on blue
blastdb icon
next to your
favorite HSP

Blast results
are displayed
in Apollo

HMMER and Clustal

- Use HMMER to detect remote protein homologs
- <https://i5k.nal.usda.gov/webapp/hmmer/>
- Use Clustal to perform multiple sequence alignments
- <https://i5k.nal.usda.gov/webapp/clustal/>

Tips and Tricks

- The i5k Workspace BLAST results persist for one week
 - You can bookmark and share searches
 - BLAST HSPs are ‘draggable’ and can be used in annotations
- Jbrowse/Apollo URLs can be shared
 - Allow you to share the exact view (including active tracks) with others
 - Great for troubleshooting with collaborators
- In Apollo “walk” feature boundaries
 - Square brackets walk exon boundaries: [and]
 - Curly brackets walk gene boundaries: { and }
- In Apollo, you can pin tracks to the top
- If you know the name or ID of the gene that you’d like to annotate, you can paste it into the search box in Apollo to navigate to it

Manual annotation example: preparation

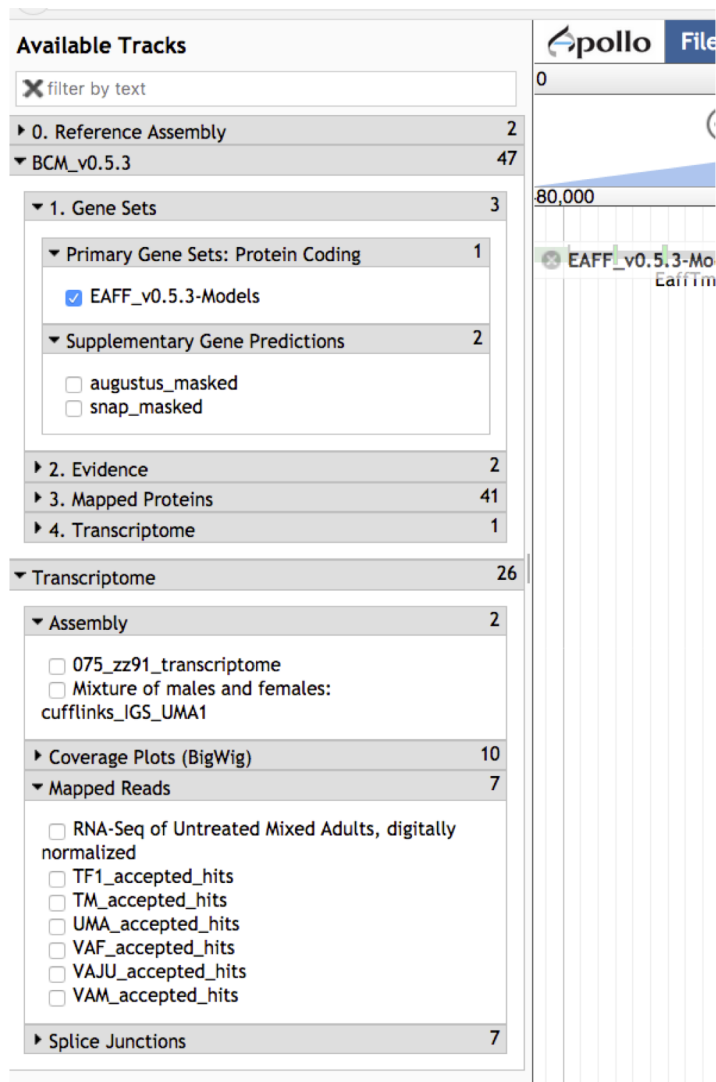
Annotation Example

- Phosphoenolpyruvate carboxykinase (pepck) in the copepod *Eurytemora affinis*
- Pepck catalyzes the conversion of oxaloacetate (OAA) to phosphoenolpyruvate (PEP).
- More information about the copepod:
https://i5k.nal.usda.gov/Eurytemora_affinis
- Apollo URL (for training only):
<https://apollo.nal.usda.gov/apollo/3068161/jbrowse/index.html>
 - Login credentials: demo/demo

Notes on *E. affinis* genome/browser

- Big advantage for annotation: lots of RNA-Seq and transcriptome data are available to use as contributing evidence for your gene models
 - Includes strand-specific RNA-Seq
- Disadvantage: No close reference genomes, so it may be harder to find homologs for your genes of interest to inform your annotations.

Available tracks for *E. affinis*



The screenshot displays the Apollo genome browser interface. On the left, a sidebar titled "Available Tracks" lists various genomic data tracks. The tracks are organized into sections: 0. Reference Assembly (2 tracks), 1. Gene Sets (3 tracks), 2. Evidence (2 tracks), 3. Mapped Proteins (41 tracks), 4. Transcriptome (1 track), Transcriptome (26 tracks), and Splice Junctions (7 tracks). The "Gene Sets" section is expanded, showing "Primary Gene Sets: Protein Coding" (1 track) and "Supplementary Gene Predictions" (2 tracks). The "Primary Gene Sets: Protein Coding" section is further expanded, showing "EAFF_v0.5.3-Models" (checked) and "Supplementary Gene Predictions" (2 tracks). The "Supplementary Gene Predictions" section is expanded, showing "augustus_masked" and "snap_masked" (both unchecked). The "Transcriptome" section is expanded, showing "Assembly" (2 tracks) and "Coverage Plots (BigWig)" (10 tracks). The "Assembly" section is expanded, showing "075_zz91_transcriptome", "Mixture of males and females: cufflinks_IGS_UMA1", and "Coverage Plots (BigWig)". The "Coverage Plots (BigWig)" section is expanded, showing "RNA-Seq of Untreated Mixed Adults, digitally normalized" and "TF1_accepted_hits", "TM_accepted_hits", "UMA_accepted_hits", "VAF_accepted_hits", "VAJU_accepted_hits", "VAM_accepted_hits". The "Splice Junctions" section is expanded, showing "RNA-Seq of Untreated Mixed Adults, digitally normalized". On the right, the main panel shows a genomic track view with a blue line representing the genome and a green line representing the gene set. The track is labeled "EAFF_v0.5.3-Models" and "EaffTm".

Track Category	Track Name	Count
0. Reference Assembly	0. Reference Assembly	2
1. Gene Sets	1. Gene Sets	3
2. Evidence	2. Evidence	2
3. Mapped Proteins	3. Mapped Proteins	41
4. Transcriptome	4. Transcriptome	1
Transcriptome	Transcriptome	26
Splice Junctions	Splice Junctions	7

- Baylor Maker annotations:
 - Primary Gene Set:
 - EAFF_v0.5.3-Models
 - Other tracks that were used to generate the primary gene set
- Transcriptome/RNA-Seq
 - Transcriptome assemblies
 - Coverage plots, Mapped RNA-Seq data, Splice junctions
 - Some of the RNA-Seq libraries are stranded

Choosing reference proteins: *D. melanogaster* pepck in UniProt

UniProtKB - P20007 (PCKG_DROME)

Display

- Entry
- Publications
- Feature viewer
- Feature table
- All None
- Function

BLAST Align Format Add to basket History

Protein | Phosphoenolpyruvate carboxykinase [GTP]
Gene | Pepck
Organism | *Drosophila melanogaster* (Fruit fly)
Status | Reviewed - Annotation score: ●●●○○○ - Experimental evidence at transcript levelⁱ

Annotation score is a heuristic for annotation quality

Organism-specific databases

FlyBaseⁱ FBgn0003067. Pepck.

Subcellular locationⁱ

Flybase is another great resource

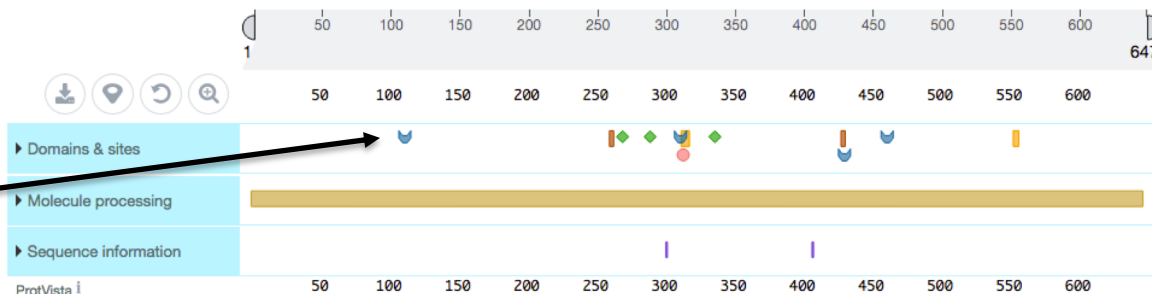
UniProtKB - P20007 (PCKG_DROME)

Display

- Entry
- Publications
- Feature viewer
- Feature table

BLAST Align Format Add to basket History

Feeds



Feature viewer gives graphical view of domains and sites

Catalyzes the conversion of oxaloacetate (OAA) to phosphoenolpyruvate (PEP).

Source: <http://www.uniprot.org/uniprot/P20007>

Choosing reference proteins: *Daphnia pulex* Pepck

- GenBank record:

<https://www.ncbi.nlm.nih.gov/protein/EFX80236.1>

```
.....
Lynch,M., Boore,J.L. and Grigoriev,I.V.
CONSRTM  US DOE Joint Genome Institute (JGI-PGF)
TITLE     Direct Submission
JOURNAL   Submitted (02-FEB-2011) US DOE Joint Genome Institute, 2800
          Mitchell Drive, Walnut Creek, CA 94598-1698, USA
COMMENT   Method: conceptual translation.
FEATURES             Location/Qualifiers
     source            1..652
```

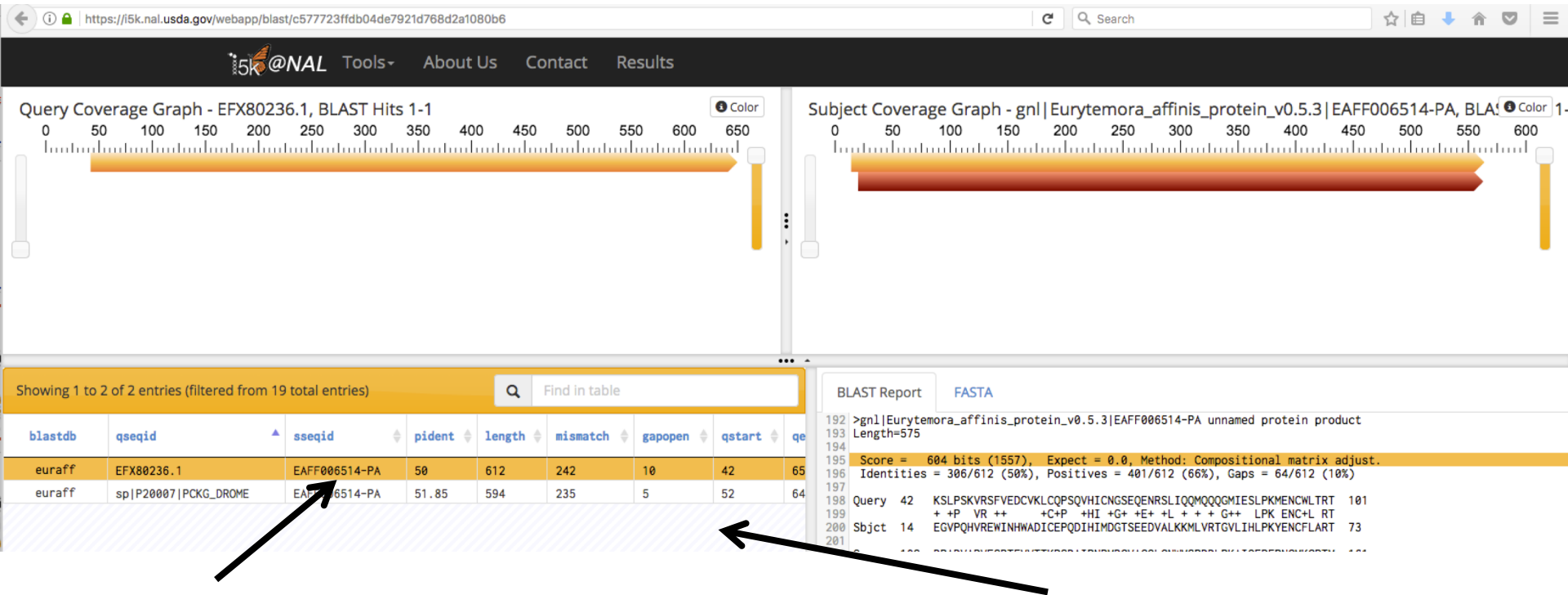
← Treat with caution!!!

Phosphoenolpy
carboxykinase,
(daphnia Phosp
carboxykinase)
(daphnia Phosp
carboxykinase)

Manual annotation live example

BLAST dmel, dpul proteins against *E. affinis* proteins

<https://i5k.nal.usda.gov/training/webapp/blast/>



Copy the protein 'base name'
EAF006514 for searching in Apollo

Results are filtered by e-value; only
one protein in the *E. affinis* dataset has
a significant match

Result URL: <https://i5k.nal.usda.gov/webapp/blast/c577723ffdb04de7921d768d2a1080b6>

Modify *E. affinis* model sequence in Apollo

- Go to Apollo URL:
<https://apollo.nal.usda.gov/apollo/3068161/jbrowse/index.html>
 - Find mRNA of EAFF006514-PA in genome browser by pasting EAFF006514 into search box, selecting EAFF006514-RA
- Log in to Apollo
- Drag EAFF006514-RA into the yellow annotation track
- Check available evidence for model

Another approach: BLAST against the genome

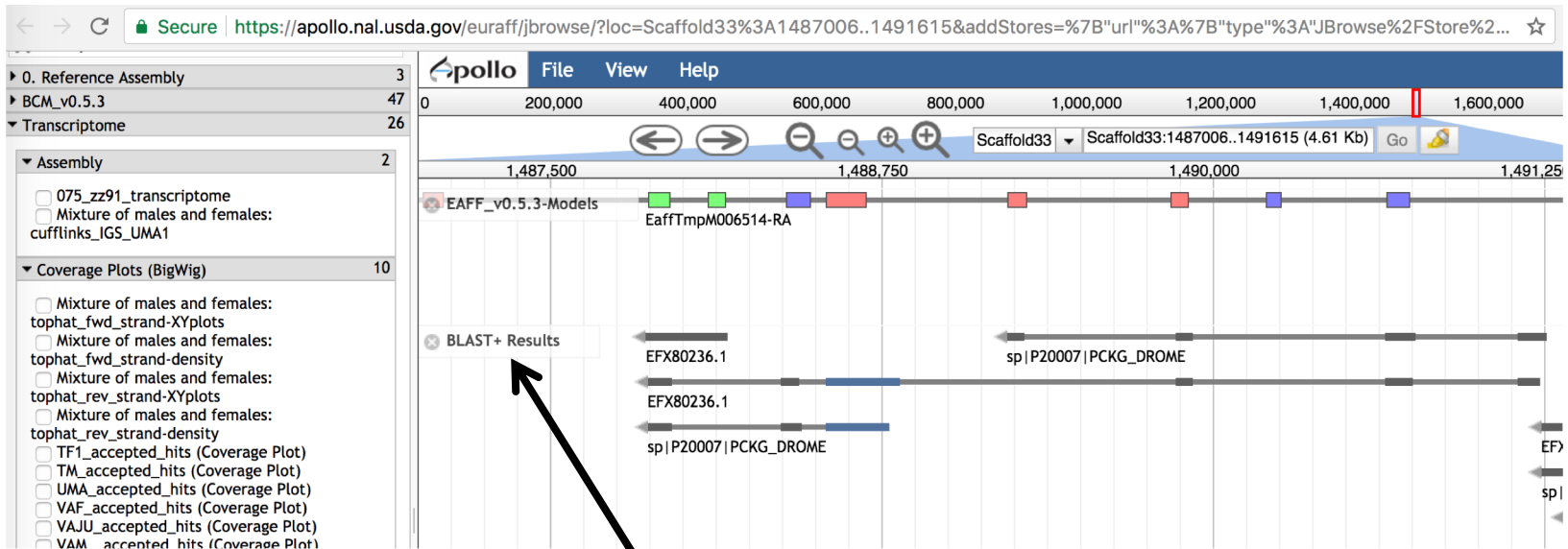
<https://i5k.nal.usda.gov/training/webapp/blast/>

The screenshot displays the i5k@NAL BLAST web interface. At the top, there are navigation links: Tools, About Us, Contact, and Results. Below the navigation bar, there are two coverage graphs: 'Query Coverage Graph - EFX80236.1, BLAST Hits 1-21' and 'Subject Coverage Graph - gnl|Eurytemora_affinis|euraff_Scaff'. The main content area shows a table of BLAST hits. The table has columns: blastdb, qseqid, sseqid, pident, length, mismatch, and gapope. The first row is highlighted in yellow and has a blue 'blastdb' button next to it. An arrow points to this button with the text 'Click on blue blastdb button next to your favorite HSP to view it in JBrowse'. Below the table, there are filters for 'Eaff_1' and 'qseqid filter'. At the bottom, there is a 'Download' button and a URL.

blastdb	qseqid	sseqid	pident	length	mismatch	gapope
euraff	Eaff_11172013.genome_new_ids.fa	Scaffold133	56.41	39	17	0
euraff	sp P20007 PKG_DROME	Scaffold133	62.5	40	15	0
euraff	EFX80236.1	Scaffold133	80	30	6	0
euraff	sp P20007 PKG_DROME	Scaffold133	78.12	32	7	0
euraff	EFX80236.1	Scaffold133	44.59	74	24	2
euraff	sp P20007 PKG_DROME	Scaffold133	46.15	78	25	2
euraff	EFX80236.1	Scaffold133	38.46	26	16	0
euraff	EFX80236.1	Scaffold133	72.34	47	13	0

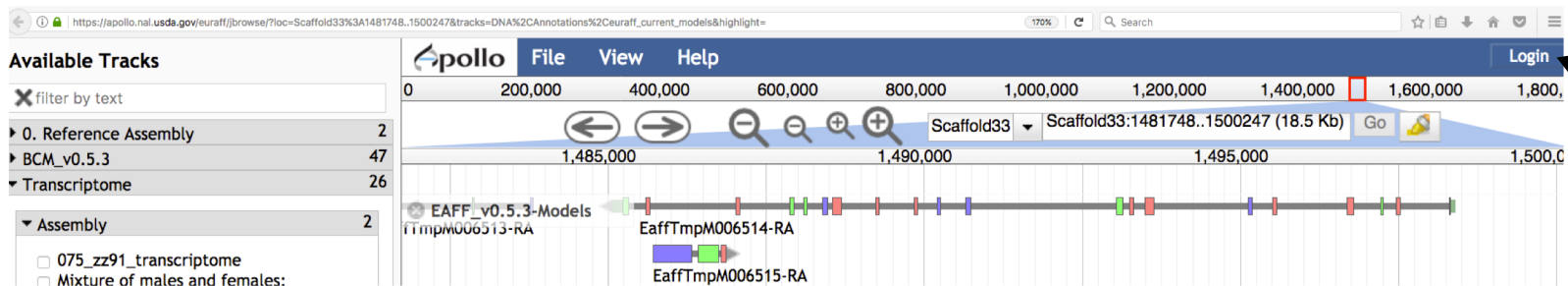
Click on blue blastdb button next to your favorite HSP to view it in JBrowse

Another approach: BLAST against the genome

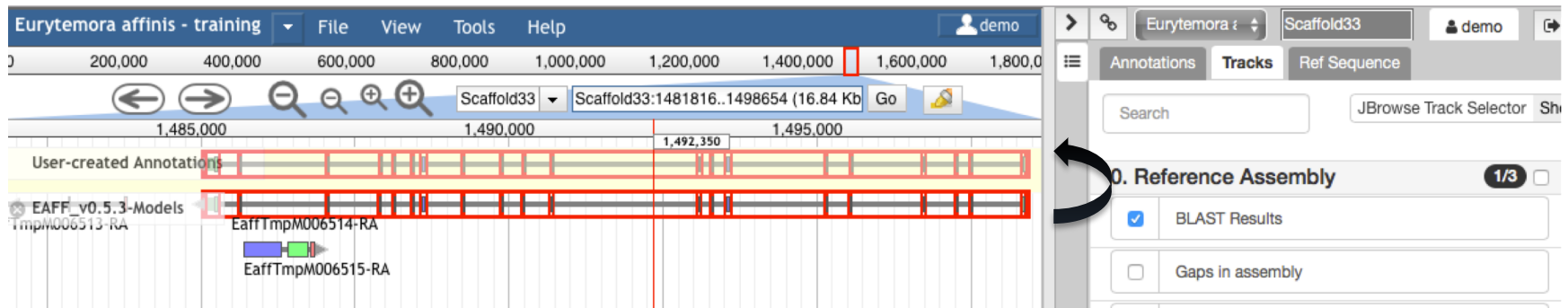


BLAST results are displayed as glyphs in browser;
can be used as annotation starting points if the
alignment is high quality

Create annotation in user-created annotations track



Log in with
your
Apollo
credentials

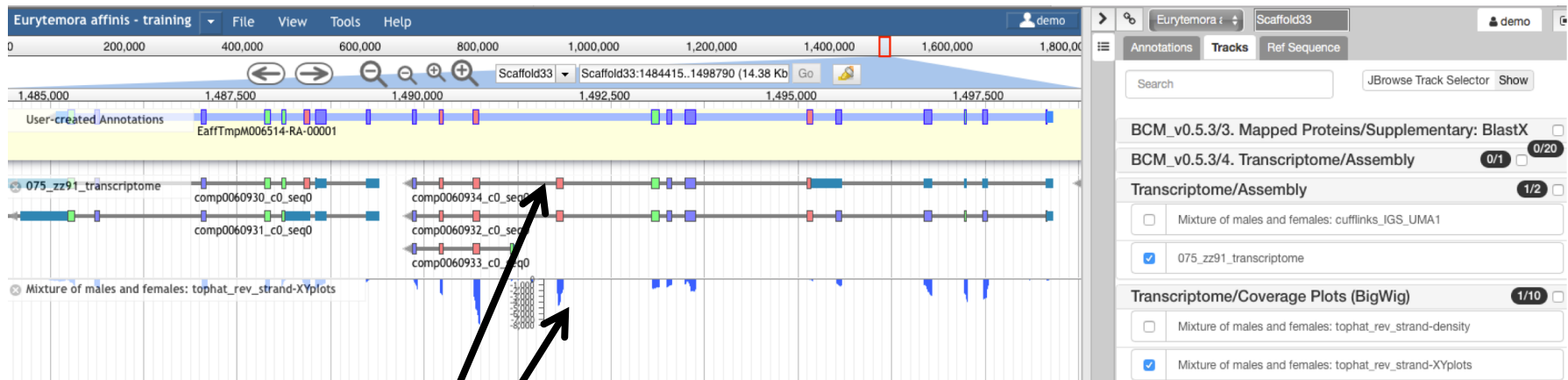


Drag model EaffTmpM006514-
RA to User-created Annotations
track

Modify *E. affinis* model sequence in Apollo

- Questions:
 - What evidence do you choose to check the integrity of the model?
 - Do you need additional evidence?
 - How do you evaluate whether the protein sequence is as complete as it can be?
 - Should you add/modify UTRs?

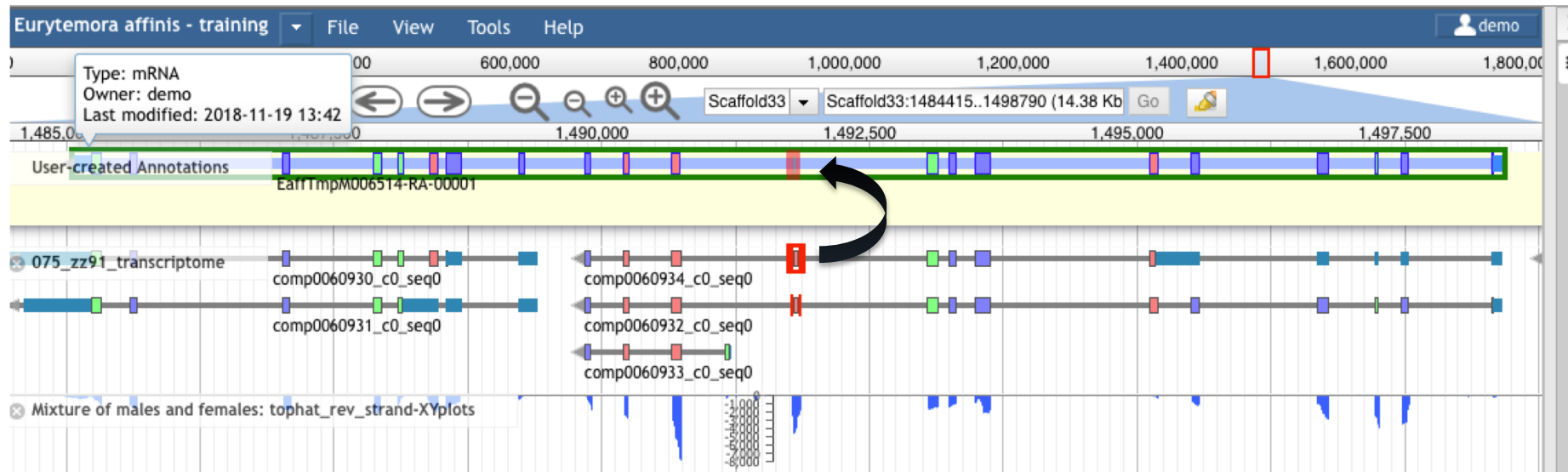
View available evidence



RNA-Seq and transcriptome tracks suggest that one exon is missing

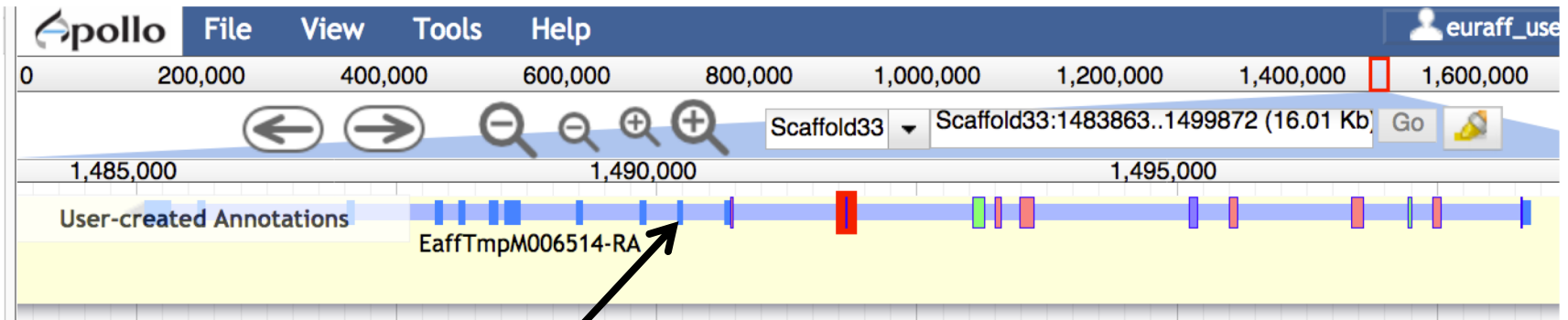
Model is on the reverse strand, so we can take advantage of the stranded RNA-Seq available for this species

Add an exon to the model

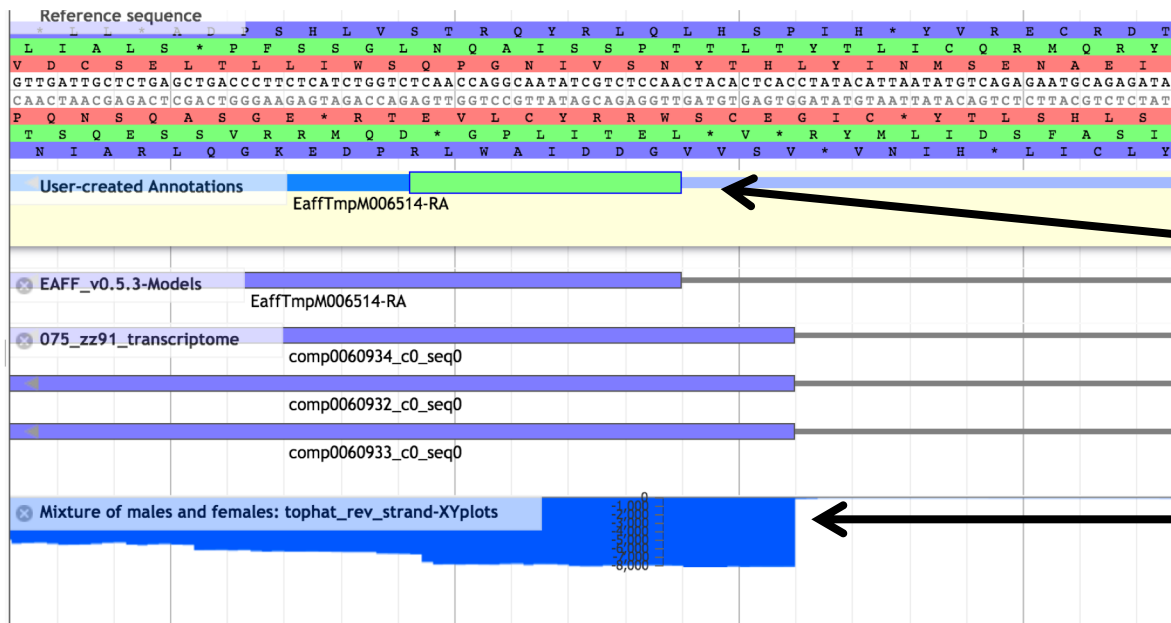


Drag exon from
transcriptome track
into new gene model

Adjust exon boundary



CDS sequence is now UTR –zoom in to investigate



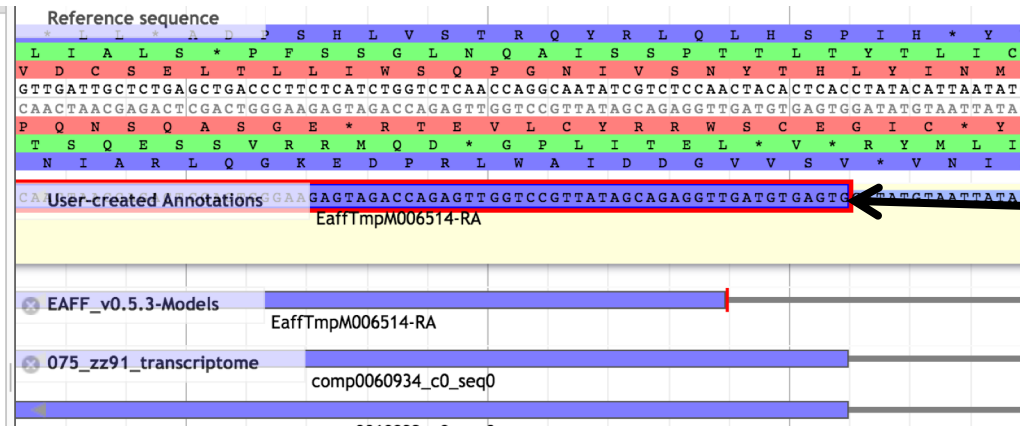
CDS frame has changed from purple to green—we need to fix this

RNA-Seq suggests we need to adjust exon boundary

Adjust exon boundary



Drag exon boundary to match RNA-Seq and transcriptome tracks



Fixed both reading frame and exon boundary

Evaluate new protein sequence

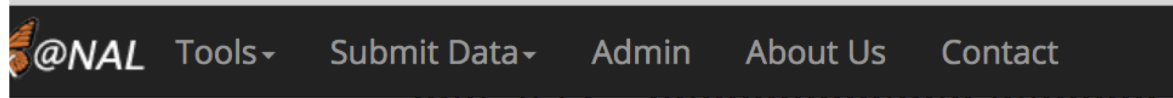
- Blast modified EAFF006514-PA sequence to NCBI's nr database
 - Make sure it doesn't match a potential contaminant
 - Get an idea whether you have the right sequence
 - Blastp home:
 - https://blast.ncbi.nlm.nih.gov/Blast.cgi?PROGRAM=blastp&PAGE_TYPE=BlastSearch&LINK_LOC=blasthome
 - Result URL:
 - <https://blast.ncbi.nlm.nih.gov/Blast.cgi?CMD=Get&RID=Z6C1S80H015>
(expires end of day 11/20)
- Once contamination is ruled out, it's better to align your sequence against a smaller set of high-quality proteins
- If you notice that parts of the protein are missing, check the 'Gaps in assembly' track in the browser

Evaluate new protein sequence

- Get *E. affinis* pepck protein sequence from old model and new model
- Align new and old sequence to dmel and dmag protein sequences
 - Clustal (<https://i5k.nal.usda.gov/webapp/clustal/>)
 - Can also use NCBI Blast
- Check alignment extent, %ID

Clustal Results

:/i5k.nal.usda.gov/webapp/clustal/105850a3594e4234a21b07d93cbbd71



euraff_old_pepck
euraff_new_pepck
sp|P20007|PCKG_DROME
EFX80236.1

```
IS-----VGDDIAWLRPDEKGQLRAI
ISGITNSQGEKKYIVAAFPSCGKTNLAMMPRLP-----VGDDIAWLRPDEKGQLRAI
ILGITDPKGEKKYITAAFPSCGKTNLAMNPSLANYKVECVGDDIAWMKFD SQVLRAI
ILGITNPQGQKKYIAAAPPSCGKTNLAMLTPTLPGYKVECVGDDIAWMHFDKEGRLRAI
*                               *****: :*.:* ****
```

New exon added

euraff_old_pepck
euraff_new_pepck
sp|P20007|PCKG_DROME
EFX80236.1

```
NPENGFFGVAPGTSYTSNPVA-----MQSIFKDTIFSNVAMTDDGGVWVEGMGDKPK
NPENGFFGVAPGTSYTSNPVA-----MQSIFKDTIFSNVAMTDDGGVWVEGMGDKPK
NPENGFFGVAPGTSMETNPPIA-----MNTVFKNTIFTNVASTSDGGVFWEGMESSLA
NPENGFFGVAPGTNYATPNACYNFFLYAMLTIQKNTIFTNVAKTSDDGGVFWEGLEKEV-
*****: :* * * : : * : : : : * : : : : : : : : : : . .
```

euraff_old_pepck
euraff_new_pepck
sp|P20007|PCKG_DROME
EFX80236.1

```
ERSSCIDWK GK-PWRPTSSNPAHPNSRFCTPLLNC PVLDESAEDPAGVP IAAILFGGRR
ERSSCIDWK GK-PWRPTSSNPAHPNSRFCTPLLNC PVLDESAEDPAGVP IAAILFGGRR
PNVQITDWLGK-PWTKDSGKPAHPNSRFCTPAAQCPIIDEAWEDPAGVPISAMLFGGRR
TGVDITSWLGDANWTKSSGKPAHPNSRFCCAPASQCPIIDPLWESPEGVPI DAILFGGRR
. . * * * * : : : : : : : : : : : : : : : : * * * * *
```

euraff_old_pepck
euraff_new_pepck
sp|P20007|PCKG_DROME
EFX80236.1

```
PSGVPLVYQAISWEHGVFMGACVKSEATAAAEFKGQIMHDPF SMRPFFG-----HW
PSGVPLVYQAISWEHGVFMGACVKSEATAAAEFKGQIMHDPF SMRPFFG-----HW
PAGVPLIYEARDWTHGVFI GAAMRSEATAAAEHKGKVIHDPFAMRPFFGYNFGDYVAHW
PRGVPLVYEALNWKHGVFVGASVSSEATAAAEHKGRS IMHDPFAMRPFFGYNAGNYLGHW
* ****: :* . * ****: :* : : ****: :* : : ****: :* : : ****
```

Another exon might be missing (we're not going to handle this today)

- Clustal result URL:

<https://i5k.nal.usda.gov/webapp/clustal/fb352efcdc7546b8ade55c7ec9e3d5cc>

Scroll to bottom of page and click 'colorful' to see color-coded alignment



Using the Information Editor

The screenshot shows the 'Information Editor' window with a genomic track at the top (400,000 to 1,400,000) and a 'Select mRNA' dropdown set to 'EaffTmpM006514-RA-00001'. The window is split into two panes: 'gene' on the left and 'mRNA' on the right. Both panes have identical form fields: Name, Symbol, Description, Created (2018-11-19), Last modified (2018-11-19), Status (radio buttons for Approved and Delete), and a table for DBXRefs with columns DB and Accession. In the mRNA pane, the 'Name' field contains 'Phosphoenolpyruvate carboxykinase' and the 'Symbol' field contains 'Pepck'.

gene	
Name	
Symbol	
Description	
Created	2018-11-19
Last modified	2018-11-19
Status <input type="radio"/> Approved <input type="radio"/> Delete	
DBXRefs	
DB	Accession

mRNA	
Name	Phosphoenolpyruvate carboxykinase
Symbol	Pepck
Description	
Created	2018-11-19
Last modified	2018-11-19
Status <input checked="" type="radio"/> Approved <input type="radio"/> Delete	
DBXRefs	
DB	Accession

Use the
mRNA/transcript
side of the IE

Review our naming guidelines
before naming:

<https://i5k.nal.usda.gov/i5k-workspace-gene-and-protein-naming-guidelines>

Using the Information Editor

- Select the model in Apollo, then right-click, and select 'Edit Information' from the drop-down menu
 - Use the 'mRNA' section
 - Name: We recommend the INSDC naming guidelines:
 - <http://www.uniprot.org/docs/nameprot>
 - If a naming convention exists, use it (e.g. for gene families)
 - Name should be unique and attributed to all orthologs (as far as possible)
 - Use name from an orthologous protein if you are sure that your gene model is an ortholog.
 - Document your justification for the name in the Comments field (e.g. "88% sequence similarity via blastp to D. melanogaster pepck P20007")
 - Comments – Document what changes you performed, and your justification for the name. These notes will be visible in the OGS, so make sure that others understand them

Checklist for accuracy and integrity

- Check start, stop and exon boundaries (splice sites)
 - Try to fix non-canonical splice sites if possible
- Check if you can annotate UTRs (e.g. using RNA-Seq data)
- Check for gaps in the genome
- If you change the genome sequence, add a justification comment to the corresponding gene model
- Use BLAST or a multiple sequence aligner
 - To look at completeness of model
 - To verify the appropriateness of the gene name
- In the Information editor **mRNA** field
 - Fill in the Replaced Model for the **Maker** gene (EAFF_v0.5.3-Models)
 - Update the Name if appropriate
 - Add comments that describe
 - your evidence for the annotation
 - Modifications that you made to the gene model

cf. <https://www.slideshare.net/MonicaMunozTorres/editing-functionality-apollo-workshop>

What happens to my annotation when I'm done?

- This depends on the genome project that you're working on.
- If the genome coordinator has asked us to generate an OGS (Official Gene Set), we will do so
 - We are still working on this process, so if you ask us to do this, 1) it will take some time, and 2) we will probably ask you for co-authorship if you publish a paper on the OGS.
 - We are working on a pipeline to submit Official Gene Sets to GenBank, where they will be archived/accessioned
- Otherwise, don't assume that your annotation will be archived.
 - If you need it to be, get in touch with us and we'll figure out what to do.
- Get in touch with us and the genome project coordinator if you're not sure about the status of a genome project.
- <https://i5k.nal.usda.gov/data-management-policy>

I5k Workspace ‘Etiquette’

1. Use Apollo to improve a gene model in an i5k Workspace assembly.
 1. If you just want to practice – use one of our training instances.
 1. <https://i5k.nal.usda.gov/jbrowseapollo-training>
 2. If you just want to view the data – you probably can get what you want without using Apollo. All of the data that we host is public.
2. Your annotation work is a community effort.
 1. If you notice that someone else is working on your model of choice, get in touch with them (or us) and collaborate – don’t make a 2nd model or delete the other model.
 2. Keep in mind that your work may be used by the scientific community once you’re done.
3. If you publish any of your work generated in the i5k workspace:
 1. Get in touch with the genome contact first (you can find the contact info on the organism page; <https://i5k.nal.usda.gov/species>);
 2. Please cite the i5k Workspace paper! This helps us continue to exist.
 1. <https://doi.org/10.1093/nar/gku983>

Thank you!

The NAL Team

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- Vijaya Tsavatapalli
- Mei-Ju Chen
- Chao-I Tuan

- i5k Coordinating Committee
- i5k Pilot Project
- Apollo & JBrowse Development Teams
- GMOD/Tripal community
- All of our users and contributors!

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