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Mitochondrial Genome Assembly and Annotation

DOI

<https://dx.doi.org/10.17504/protocols.io.kqdg3xeqqg25/v1>

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Protocol status: Working

We use this protocol and it has worked for us in the past.

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Last Modified: November 09, 2023

Protocol Integer ID: 83144

Keywords: mitochondrial genome assembly, invertebrate mitochondrial genome, mitochondrial genome, assembling invertebrate, phylogenetic tree, genome, annotation

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Disclaimer

I have used the protocol, and it has worked for me, however I am not guaranteeing that this protocol will work.

Abstract

This is a step by step protocol for assembling invertebrate mitochondrial genomes, annotating the genomes , publishing the genomes and then step by step protocol for making a phylogenetic tree using the data from the mitochondrial genomes



Novoplasty v4.3.1

- 1 After QC, we ran our illumina short reads through a program called Novoplasty v.4.3.1. for mitochondrial genome assembly.

Citation

Dierckxsens N, Mardulyn P, Smits G (2017)
. NOVOPlasty: de novo assembly of organelle genomes from whole genome data.

<https://doi.org/10.1093/nar/gkw955>

LINK

Next you want to upload a seed and a reference file. The seed is where you would want the assembler to start assembling the program. I used the COI of an already published mitochondrial genome. Next you will want to upload the reference genome. I used the already published mitochondrial genome of the sea spider *Achelia bituberculata*. Then you want to create a config.txt file for your assembly. It should look like this:

Project:

Project name= A_M

Type= mito

Genome Range= 12000-22000

K-mer = 33

Max memory=

Extended log= 0

Save assembled reads= no

Seed Input= /mnt/home/zehnp1jrCMICH/NOVOPlasty/NOVOPlasty/Seed.fasta

Extend seed directly= no

Reference sequence=

/mnt/home/zehnp1jrCMICH/NOVOPlasty/NOVOPlasty/reference.fasta

Variance detection=

Chloroplast sequence=

Dataset 1:

Read Length = 151

Insert size = 300

Platform= illumina



Single/Paired = PE

Combined reads=

Forward reads = /mnt/home/zehnp1jrCMICH/NOVOPlasty/NOVOPlasty/M_R1.fastq

Reverse reads = /mnt/home/zehnp1jrCMICH/NOVOPlasty/NOVOPlasty/M_R2.fastq

Heteroplasmy:

MAF =

HP exclude list =

PCR-free=

Optional:

Insert size auto= yes

Use Quality Scores= no

Then you will want to create a submission file (.sh file) it should look like this:

```
#!/bin/sh --login
#SBATCH --time=5:00:00
#SBATCH --nodes=1
#SBATCH --cpus-per-task=20
#SBATCH --mem=250G
#SBATCH --mail-user=zehnp1jr@cmich.edu
#SBATCH --mail-type=FAIL,BEGIN,END
#SBATCH -J A_Mitochondrial
```

```
cd ${SLURM_SUBMIT_DIR}
```

```
perl NOVOPlasty4.3.1.pl -c config.txt
```

```
scontrol show job $SLURM_JOB_ID
```



Then you want to submit the job. If using a cluster its a good idea to submit as a job rather than run in the terminal as you will most likely run out of resources and your task will be terminated in the terminal.

- 2 Submit consensus file from Artemis to MITOS for Annotation.

Citation

Bernt M, Donath A, Jühling F, Externbrink F, Florentz C, Fritzsche G, Pütz J, Middendorf M, Stadler PF
(2013). MITOS: improved de novo metazoan mitochondrial genome annotation.

<https://doi.org/10.1016/j.ympev.2012.08.023>

LINK

This will be the .fasta file from NOVOPLasty.

- 3 Next you will want to take annotations from MITOS2 and manually check gene boundaries in Artemis

Citation

Rutherford K, Parkhill J, Crook J, Horsnell T, Rice P, Rajandream MA, Barrell B (2000)
. Artemis: sequence visualization and annotation.

<https://doi.org/>

LINK

- 4  Ammothea_clausi_example.tbl  Mitogenome_notes_aftermitos (1).txt

Next I followed these steps for my submission to NCBI.

- 5 Phylogenetic tree building with protein coding gene data

 Phylogenetic_tree_notes.txt

