

## Supplementary data file 8 "Ana7120 tRNAs".

### The tRNA transcriptome of *Anabaena* 7120.

Transfer RNAs are housekeeping genes usually expressed constitutively at high levels. Therefore it is of interest to identify their promoters in order to define a consensus constitutive promoter. This could also help in the design of promoters for the engineering of high level expression of genes of interest in Cyanobacteria. tRNAs are transcribed as 5'-extended precursors that are rapidly processed by RNase P, and the 5' leader fragments generated by RNase P are degraded. Processing is very fast, and precursors or 5' leaders are not easily detectable by northern blot hybridization. Standard procedures to identify the 5' ends of RNAs such as primer extension or nuclease protection assays usually identify the 5'-end of the mature tRNA but not the authentic TSS. Therefore only very few TSS for tRNA genes have been identified experimentally so far.

Because of the high sensitivity of the dRNA-seq procedure here sufficient numbers of reads were obtained to unambiguously identify TSS for most tRNA precursors (see list at the end of this file). Only for a small number of tRNAs no TSS was identified. Some of these are probably cotranscribed from upstream genes (tRNA-Arg-CCT, tRNA-Thr-GGT, tRNA-Arg-CCG) or are transcribed within ribosomal operons (tRNA-Ala-TGC and tRNA-Ile-GAT). Others with no upstream reads detected (tRNA-Val-TAC, tRNA-Thr-TGT) might be processed too quickly to accumulate enough precursors for detection in dRNA-seq.

A total of 37 TSS were identified for 35 tRNA genes. Two genes have two TSS. From the aligned TSS a consensus -10 sequence could be found at 5-8 bp of

TSS (**Figure S2A**). A -35 sequence is found in most tRNA genes at 17-19 bp from the -10 sequence. In two cases the distance is only 14 bp and in another it is 22 bp, therefore their relevance is doubtful.

The length of 5'-leader sequences can be as short as 5 nt and longer than 200 nt, but most are between 10 and 20 nt (**Figure S2B**).

One of the two tRNA-Asn-GTT encoded in the chromosome, *trnN-GUU(1)*, has a long leader (162 nt) and there is an asRNA that fully overlaps its promoter.

This asRNA is *hetR*-dependent but independent of nitrogen status.

### Overview on tRNA dRNA-seq data

Sequences upstream from mature tRNAs in green, TSS in red, mature tRNA in black.

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>640697052 tRNA-Pro-TGG [Anabaena sp. PCC 7120: NC_003272] (+)strand
TATGTTTTGGTATCCTCATTAAATTTTTCCGCTAAAGAAACATAGCCAAT
ATCTAAAAAATCAGCTATGATAGCTAAAGCTTGTGTGAATAAAGTGAAAT
CGGGATGTAGCGCAGCTTGGTAGCGCGCCTGCTTTGGGAGCAGGATGCCG
CAGGTTCAAATCCTGTCATCCCGA
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>640697053 tRNA-Leu-CAA [Anabaena sp. PCC 7120: NC_003272] (-)strand
GATACTAGTTTTCTGCATTTGTAAGTAGGTAGAGGAGAATTTTAATTTAT
TCCTTGCAATAAACTTAATTGCTGTACTATAATTGTGAAAGTTGCCTCCAA
GGCGGGTGGCGAAATTGGTAGACGCACCACACTCAAATGTGGCGACCT
TGCGGTCATAGGAGTTCGATTCTCCTCCTGCCCCA
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>640697054 tRNA-Leu-CAG [Anabaena sp. PCC 7120: NC_003272] (+)strand
CATCATGACTCAACAGATTGCCTGCAAAATCTTTCCTGGCAAAGTTGACA
GGCTTAAATAATTAAGCAATAATAAGAAATTGTCGATATGCACACCGCAA
GCGGAACTGGCGGAATTGGCAGACGCGCTAGATTCAGGTTCTAGTGCCGC
AAGGCTTCCGGGTTCAAGTCCCGGGTTCCGCA
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>640697055 tRNA-Arg-CCT [Anabaena sp. PCC 7120: NC_003272] (-)strand
ACACAGTTATCTTTGTGGTTTAGAAATAGGTGGTATTCTTGGAGCAATT
CTTGGCAGTCTAGTTAGAACTACTGCTATCATTGTATATGCTTCACAGTT
GGGGCTGTAGCTCAGTTGGATAGAGCGAGCGCCTCCTAAGCGCTAGGTCG
TGC GTTCAAGTCGCACCAAGTCCCG
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*No TSS detected. Probably cotranscribed with upstream gene (all0245)*

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>640697056 tRNA-Ala-TGC [Anabaena sp. PCC 7120: NC_003272] (+)strand
TATAAATGCAGCAACGATTTGCGTATTTTCTTGGTTCATCCCTTTGTAA
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AAAACAGAGTTTTTCGGTTATGATAGCGGAGACTAATAAATTCAATTTTAC  
GGGGGTTTAGCTCAGTTGGTAGAGCGCCTGCTTTGCAAGCAGGATGTCAG  
CGTTTCGAGTCCGCTAACCTCCA

>640697057 tRNA-Val-TAC [Anabaena sp. PCC 7120: NC\_003272] (-)strand

AGGGCATTTACAAGCTTCTCAAAAATACTTAAAAAAATTTCTCAAAAT  
ACTAGCGCGATTCAAAAATTTTTGCTATATTGATTGTTAGTGAAATGAAC  
GGGCGGTTAGCTCAGTTGGTAGAGCGCCTGCCTTACAAGCAGGATGTCAT  
CAGTTTCGAGTCTGGTACTGCCCA

*No TSS detected*

>640697058 tRNA-His-GTG [Anabaena sp. PCC 7120: NC\_003272] (-)strand

TTTGCAATCCCAAGACTCTCAATCAGTAAAGTCCGTTCCACAAAAAAA  
AAATTCTGGATAAGTTTACTAAACAGGTGCTATAATAAGAATGTGTGTG  
GCGGGCGTAGCCAAGTGGTTAAGGCAGTGGATTGTGGTTCCACCATTCCG  
GGTTCAAGTCCCCTCGTTCGCC

>640697059 tRNA-Asn-GTT [Anabaena sp. PCC 7120: NC\_003272] (+)strand

TTATCAGTGTTCGGTTAGTGATTAGTCCACCAGGGGAGACGGTCTAGT  
TTAATACTTAGACTACCGCCTTAAATTTTCTATGCTACATTGGGTTACA  
AGATAGTAATACATTTGCCGAGCTATGGTTTGGGTTCTGTATACCCGACT  
GGTGCGCCAACCTCTGGATTGAGCGTATACCGCAAAGTAATAAGTTACTA  
TTTTACCCCGTTTGATAAGGTCAGTGGCAGAGCCGATAAAGCTTATGCTA  
CATCAAACACAC

GAAAGTTAGCTCAGTGGTAGAGCGATCGACTGTTAATCGATATGTTGTA  
GGTTCAACTCCTATACTTTCT

*Long leader, HetR-dependent*

>640697060 tRNA-Phe-GAA [Anabaena sp. PCC 7120: NC\_003272] (-)strand

AGTTGTACTTCAAGGCAGCATAAATCTTTTTTTTACGAAAATATTGCCA  
AATCGTTTTATGTTTGCTACATTGATTAATCGTGGTCAAGAAAAAACA  
GCCGGGATAGCTCAGTTGGTAGAGCAGAGGACTGAAAATCCTCGTGTAC  
GAGTTCAAGTCTCGTTCCTGGCA

>640697061 tRNA-Glu-TTC [Anabaena sp. PCC 7120: NC\_003272] (+)strand

GTGAGAATTCCCTTCTTCTGTCCCAAGCCGAAAATTTTTTTCCCGACCT  
ATTGACATCACCTGAAAAATCCGTTAATTTATAAAAGTCTGAGGTTGAT  
GCCCCATCGTCTAGAGCCTAGGACACCTCCCTTTCACGGAGGTAACGG  
GGATTCAATTCCCCTGGGGTA

>640697062 tRNA-Leu-GAG [Anabaena sp. PCC 7120: NC\_003272] (-)strand

TATATTTAGCAAGATAAATTTTCCATAAAGTTTGGCAAATATAGTTTTAC  
CTTGTTTTTATGCAATTTTTTTGTGCTAGTATATCTTCTGTGTACAACCCGT  
GCGGATGTGGCGGAATTGGTATACGCGCACGCTTGAGGTGCGTGTGGCTT  
TGCTTGCAGTTCGAGTCTCGCCATCCGCA

>640697064 tRNA-Arg-TCT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 AGCCTTGCATCGGTAAATCTGCAATTTTTTTGTTTCTTATGAAAGA  
 AAACGATATAATTACCTG<sup>G</sup>ATGACTCCTATGGGAGCCTGAGTATTAECTT  
 GGGCGCGTAGCTCAGTGGATAGAGCCACGGATTTCTAATCCGTTGGTCGC  
 AGTTTCGAACCCCTGCCGCGCTCG

*1 read*

>640697065 tRNA-Tyr-GTA [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 GCACTTACTACAAACTCTTTTTGGTGTCTCCAAAAATTTTTTATTACCC  
 ACTTGCCATTTCTAAAATACGCTGCTATTATTGTAAAT<sup>T</sup>CGTGGGACATAC  
 GGGTCGGTGTCCGAGTGGTTAATGGAGACGGACTGTAAATCCGTTGGTTT  
 ACACCTACGCTGGTTCAAATCCAGCCCGGCCCA

>640697066 tRNA-Thr-GGT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TTGGTTTACACCTACGCTGGTTCAAATCCAGCCCGGCCACCTTCAATTT  
 TAGATTTTTGAATTATAACCTAGTTCAAATCTAAGATTTAAATAAATTC  
 GCCCGTGTGGCTCAGTGGTAGAGCACACCCTTGGTAAGGGTGAGGTCACG  
 AGTTCAATCCTCGTCACGGGCT

*cotranscribed with upstream tRNA<sup>Tyr</sup>*

>640697067 tRNA-Gly-CCC [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 GCTGCACGTTTTGTATAAGAGATTGTGCCAACACATAATGGAAATGCAGA  
 TATTATCTACACTGCAAAAATAGTGTATAATTCTACCT<sup>G</sup>TGCTGTTAAT  
 GCGGGCGTAATTCAGTGGTAGAATGTCACCTCCCAAGGTGAACGTCGTG  
 GGTTTCGAGTCCCATCGCCCGCT

>640697068 tRNA-Gln-TTG [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 CACAAGGCTTTACAGCACTTATTACTTAGTTCAGAATTTTTTTCAAAGT  
 ACTTGACATATCCCCTACACAGACTGCTATATTAATAAA<sup>G</sup>TCGAAAGCTT  
 TGGGGCGTCGCCAAGTGGTAAGGCATCGGGTTTTGGTCCCGACATCCCTA  
 GGTTCGAATCCTAGCGCCCCAG

>640697069 tRNA-Pro-CGG [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TCCCGTTCCGATTCATCTATATATAATATATAGATG<sup>T</sup>AGATATCTTTTCG  
 GTATTGACTATTATTTATGTTATGCTAAGGGG<sup>G</sup>CCGTATAATTTTTTTAA  
 CGGGATGTAGCGCAGCTTGGTAGCGCACTTCGTTCCGGACGAAGGGGCCG  
 CTGGTTCGAATCCAGTCATCCCGA

*Heterogeneous TSS? Few reads*

>640697072 tRNA-Ile-GAT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TGAGAATCGAAAGCGTAAAGCGAATAGAGGAACAGATGGTCTACTCTAGG  
 TCGGTCGTAGATATTGTCAAAGCTTTCAAACCTATGATTTGGTTCGATAAT  
 GGGCTATTAGCTCAGGTGGTTAGAGCGCACCCCTGATAAGGGTGAGGTCC  
 CTGGTTCGAGTCCAGGATGGCCCA

>640697073 tRNA-Ala-TGC [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TCCAGGATGGCCACCTGAAGCAAGTCAAAGTTAAAAGACAAAAGTCAA

AAGTAGTTATTTACTTTTTGAATTTTGGATTTTGAATTTTGAATTGTATTT  
 GGGGGTTTAGCTCAGTTGGTAGAGCGCCTGCTTTGCAAGCAGGATGTCAG  
 CGGTTTCGAGTCCGCTAACCTCCA  
*ribosomal operon*

>640697077 tRNA-Ile-GAT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TGAGAATCGAAAAGCGTAAAGCGAATAGAGGAACAGATGGTCTACTCTAGG  
 TCGGTTCGTAGATATTGTCAAAGCTTTCAAACATGATTTGGTTCGATAAT  
 GGGCTATTAGCTCAGTTGGTAGAGCGCACCCCTGATAAGGGTGAGGTCC  
 CTGGTTCGAGTCCAGGATGGCCCA

>640697078 tRNA-Ala-TGC [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TCCAGGATGGCCACCTGAAGCAAGTCAAAAGTTAAAAGACAAAAGTCAA  
 AAGTAGTTATTTACTTTTTGAATTTTGGATTTTGAATTTTGAATTGTATTT  
 GGGGGTTTAGCTCAGTTGGTAGAGCGCCTGCTTTGCAAGCAGGATGTCAG  
 CGGTTTCGAGTCCGCTAACCTCCA  
*ribosomal operon*

>640697081 tRNA-Arg-CCG [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 CATCTGCATTTTTGAAGTTCGTGCAATGGTACACCAGTCAACCCAGCAGA  
 TTATCTTTAGCCAAAATCTTCTGGAGCATGATATAATTAGCCAGTACGA  
 GGGCGCGTAGCTCAGTGGATAGAGCAACAGATTCCGGTCTGTGGGTCGG  
 GGGTTCAAATCCCTCCGCGCTCG  
 No TSS detected. Probably cotranscribed with upstream gene (*asl2362*)

>640697082 tRNA-Leu-TAG [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 CTCGTGTAGGCGTGATGTGATTGTTACGAATTTTTAACTAATACCTATTA  
 TCTATTGCCTATTCCCTGAGATAAAGTGCTATACTAGTATAGTTGCATAA  
 GCGGATGTGGCGGAATTGGCAGACGCGCTAGATTTAGGTTCTAGTTCCGA  
 GAGGAGTGAAGGTTCAAGTCCTTTCATCCGCA

>640697083 tRNA-Ala-GGC [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 CCCATGTTATTTATATTAAGGATGATTCTATTGCATCCACATTTGTCAAACCCATTTACA  
 CTAGGTATTTACCATTTGCGGATGAGTCTAATATAATAAGCATTATGCTAATGTACATAA  
 GTTTTAATAATGTTAAGTATTTATAAAATAAGTAATACTTGGTTTAAATTGCTCGATTAT  
 GGCATACAATGGCAGAATGCCATAAAAAAATAAAAAAATAATTAAGTTAATTC  
 GGGGTTATAGCTCAGTTGGTAGAGCACTTCAATGGCATTGAAGGGGTCAG  
 CGGTTTCAATCCGCTTAACTCCA  
*Long leader*

>640697084 tRNA-Lys-TTT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 ACAAAGCATCTGTAAGATTGTCGGCAAGTTTTTTCTAAAAACCCTTTACA  
 AGTCTACGGTTGTTTATGCTATGATGGCAAAGTTGCGAAACAAACCGCAA  
 GGGTCGCTAACTCAACGGTAGAGTACTCGGCTTTTAAACCGATTAGTTCCG  
 GGTTCGAATCCCGGGCGACCCA

>640697086 tRNA-Val-GAC [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TGAAGGGCAAAGACTACTGGCTTTGGCGCAGAAGCGACTGAAACAATAAA  
 ACTTTGCTTTTATGAAAAATGTGTGTTACTGTTATAAA<sup>T</sup>CGTGTGGTTAA  
 GGACGTATAGCTCAGTTGGTTAGAGCGCTACGTTGACATCGTAGAGGTCA  
 CTGGTTCGAATCCAGTTACGTCCA

>640697087 tRNA-Ser-GGA [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 TCGGGATTTTGATTGGGACTTTCAGATTGCTCTAAAAAATTTCTTTCTTT  
 ATCTTTGCATTTTTTTAGAGTTTCAGCGTACAATAGTAA<sup>T</sup>CGTGACATCT  
 GGAGAGATGGCCGAGTGGTTTAAGGCGCAGACCTGGAAAAGTCTGTAATGC  
 GGAAACGTATTCTAGGGTTCAAATCCCTATCTCTCCG  
*TSS further upstream antisense to ferredoxin*

>640697088 tRNA-Ser-CGA [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 GGAAAACCTCAGCATCAAATTCATTACAGGGTCATGTTTTGAGTTTTCCCATAGTCA  
 AGACTTCTCTAACAACTTGTTAAATGCTATTATTTTGT<sup>T</sup>CGGAAAACCTGAGCTTAGTCAT  
 TTCCGATTGCTAGCGATGGGTAGGTGATCGCTTCACCTAACGAGATGCTATCATGACAAA  
 AGGAAAACCTCTGTATCAACAGTTTCCTAAATGAATAAATATCT  
 GGAGAGGTGTCCGAGTGGTTGATGGTGACGCACTCGAAATGCGTTAAGGA  
 TGCAAGTCCTTCGGGGTTCAAATCCCCCTTCTCCG  
*Long leader*

>640697089 tRNA-Asp-GTC [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 CGTAAATCCTAGAAGTTCAAATCTGAGCTAAAAAGGAAATTTTCATAAATA  
 AGGTTGACAAATCCTTGGAGTTTCGTCATAATAGGGA<sup>A</sup>GTTGCCAATTAA  
 GGGACTGTAGTTCAATTGGTTAGAGCACCGCCCTGTCACGGCGGAAGTTG  
 CGGGTTCGAGCCCCGTCAGTCCCG

>640697090 tRNA-Arg-ACG [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 TGCCTGTCCCTGGCCATCTAGATGAGTAAGGTTTGCAGAATTTTTGGGAA  
 AAGGGGCTTGATAATTAGGAAAAATGGTGATAGTATATATTT<sup>C</sup>TTGTAA  
 GGGCGTGTAGCTCAGTTGACTAGAGCACGTGGCTACGGACCACGGTGTGC  
 GGGGTTCGAATCCCTCCTCGCCCCG

>640697091 tRNA-Gly-TCC [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 GCCGTTATTAAGATATGTTTTGGTATGAGCTTCAGTGCAAATCTGTATTCATTATTGTGGTTTGCAC  
 CTAGTAGATTTTCTGCTATACTTGTCTGA<sup>A</sup>GTTTCATACATAAAGACCTACAAAGCAATAGAAAATCATGT  
 CTATTGCTTAAACCGAGCTTATGTATCGGGTTACGGCTTCAATAACTGAAGCGTTGTTAGC  
 GCGGGCGTAGTTTAGTGGTAAAACTATAGCCTTCCAAGCTATTAATGCGG  
 GTTCGATTCCCGCCCGCCGCT

>640697092 tRNA-Ala-CGC [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 AGAATTTCCGGCGATCGTGAGTGAGTGTTAAGATATTGTCT<sup>G</sup>GATAGTATG  
 GCGTTGATTAGGTAAGCATAGTTTGATCAACTTACCATTACAGCTATCTAA  
 GGGGAATTAGCTCAGTTGGTAGAGCGCTGCGATCGCACCGCAGAGGTCAG  
 GGATTGAGTTCCCTATTCTCCA

*promoter overlaps upstream gene*

>640697093 tRNA-Thr-CGT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 CCATCTCTGCTTTCAGGCGGCATATTGTTTCAGGATCAAACGCTTTTTG  
 GGATTAGGTTCTACCATAAGTAAATAATGCTATAATCTCTTATCGTATAT  
 GCCGATGTGGCTCAGTGGTAGAGCAGCTGATTCGTAATCAGCAGGCCGTG  
 GGTTCAAATCCCATCATCGGCT  
*Heterogeneous TSS*

>640697094 tRNA-Gly-GCC [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 GTCCTATTGATTAGTCTCCAGCCCTCAGTTAGCAAATTTACAAGTTTAA  
 ACAGTTGACAAAATAAAAATTAATCTGGCATATTTAGATATAGTGAAGTTT  
 GCGGGTATAGCTCAGTGGTAGAGCGTCACCTTGCCAAGGTGAATGTCGCG  
 CGTTCGAATCGCGTTACCCGCT

>640697097 tRNA-Ala-TGC [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 TCCAGGATGGCCACCTGAAGCAAGTCAAAGTTAAAAGACAAAAGTCAA  
 AAGTAGTTATTTACTTTTTGAATTTTGGATTTTGAATTTTGAATTGTATTT  
 GGGGGTTTAGCTCAGTTGGTAGAGCGCTGCTTTGCAAGCAGGATGTCAG  
 CGGTTTCGAGTCCGCTAACCTCCA

>640697098 tRNA-Ile-GAT [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 TGAGAATCGAAAAGCGTAAAGCGAATAGAGGAACAGATGGTCTACTCTAGG  
 TCGGTTCGTAGATATTGTCAAAGCTTTCAAACATGATTTGGTTCGATAAT  
 GGGCTATTAGCTCAGTGGTTAGAGCGCACCCCTGATAAGGGTGAGGTCC  
 CTGGTTTCGAGTCCAGGATGGCCCA  
*ribosomal operon*

>640697101 tRNA-Met-CAT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 CCAGGCAAATACACGCGTTTAGAGGTTGTTGGAGAATTATCGCTTTTATA  
 GTTGCCAAACTTTTTGAGTTTGGGTTATACTTGAAAAGTCAAGAAAAACGA  
 CGCGGGATAGAGCAGCCTGGTAGCTCGTCGGGCTCATAACCCGAAGGTCA  
 GTGGTTCAAATCCACTTCCC GCCA

>640697102 tRNA-Asn-GTT [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 GAAATAATCTAGATAAGAAAGCTACTGGAAAATTTTTTTTGAAAAGTAC  
 TTGCCATATCCTATCGACTACGATAATATTATAAAATCGTGAGAGCAACGT  
 TCCTCAGTAGCTCAGTGGTAGAGCGATCGACTGTTAATCGATTGGTCACT  
 GGTTTCGAATCCAGTCTGGGGAG

>640697103 tRNA-Met-CAT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 AACTACGCTTACTTATATCAAGCAACCAGAGAAAATTCATTTCCAGAAT  
 ACTAGACAAAATAAATTTATCAGCTATATTAAGAAATGTGTGAAAACAC  
 GGCTCAGTAGCTCAGTTGGTTAGAGCACGGGACTCATAAGCCTGGGGTTCG  
 TTGGTTCAAATCCGACCTGAGCCA

>640697104 tRNA-Pro-GGG [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 CTGCTGTACCTAGTCTGTTGCAAGCTACGGGAATGCTCAAAGTTTTTTGA  
 ATTTACCCCTTGATTTTACAAAAGCGTTTGGCGATAATATAGTAATTCGAC  
 CGGGGCGTAGCGCAGCTTGGTAGCGGCCACTTTGGGGTAGTGGAGGTCG  
 TGGGTTCGAATCCC GCCGCTCCGA

>640697105 tRNA-Ser-TGA [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 CCAGTAGTACCATCTGTGTAGATGATAGGATATAGTATTATCTGTCAGCT  
 TTATTGCTCACCCACAAAAACAGGGTGGCAGTGGCTCGACAGTTTATTT  
 GGAGAGGTGGCAGAGTGGTCAATGCACTCGACTTGAAATCGAGCGAGGC  
 GAAAACCTCCGGGAGTTTCAATCTCCCCCTCTCCG

>640697106 tRNA-Leu [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 CTGAACTGAAAGCCTGGAGACACCATAAATATTGGGCTTTTAAATGAGTCCAGCAAAAATTCCTGATTCT  
 TGCTGATCAAAATTATAAGATAATGCTACAATGGCAAAGCCAGTAAAGAAGTAGTGTCTTGTGCGGGCAA  
 GATTGAAGATGCTAAGTCTAGTTAAATGCGAGGAAGCAAATGCAACTCTCAGCTAGCTACAGCTAATTTCC  
 CCAGGGGAGATAAAAAATTTTCAATCTAGTTGGACAAAATACGCATTTAATGGTGAATATATGAGGGGG  
 TATTTGCTGCCTCCAAAATATAACAAGCTCCCAGCACAATGG  
 GGGGGTGTGGCGGAATGGTAGACGCTACGGACTTAAATAATTGAGCCTTA  
 GAGAAGAAATTCCTTAAGTGGATGCTCTCAAACCTCAGGGAAACCTAAATC  
 TAGCTATAGACAAGGCAATCCTGAGCCAAGCCGAAGTAGTAATTAGTAAG  
 TTAACAACAGATAACTTACAGCTAATCGGAAGGTGCAGAGACTCGACGGG  
 AGCTACCCTAACGTCAAGACGAGGGTAAAGAGAGAGTCCAATTCTCAAAG  
 CCAATAGGCAGTAGCGAAAGCTGCGGGAGAATGAAAATCCGTTGACCTTA  
 AACGGTCGTGTGGGTTCAAGTCCCTCCACCCCA

*Group I intron*

>640697107 tRNA-Thr-TGT [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
 CCCTTCCACCAAGCCAAATTAAGTTGCTCTAGAGGTAGACAAATAAATTA  
 CTTGTGATATAAATAAAAATCGGTAAGTGCGTAAAGCAATTACTGAGTT  
 GCCAGCATAGCACAGTGGTAGTGCATCCGACTTGTAAATCGGAAGGTCGTC  
 GGTTCAAATCCGACTGCTGGCT

*no TSS detected*

>640697111 tRNA-Met-CAT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 GTTCCCCTATTCCATAAATTAATGATGTAGTATAAAAAATCTAATAAATT  
 ATCTTAGAAGGTACACAAGCTTTTACTACTCTAAGATACAATTGTAACTAA  
 CCAGGGTTGGCCGAGCGGTTGAGGCAGCGAACTCATAATTCGCCAAGGC  
 AGGTTCAAATCCTGCACCCTGGA

*ambiguous*

>640697112 tRNA-Lys-CTT [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
 AGAGTGGTCATGGTCAAACCACTTTTATAATCAGATTTCCCGGCTCACTC  
 AGCTAAATCTTGGCAGAACTACAGAAATTTGTTAATATAGTGATTGGTGT  
 GGGTGACTAGCTCAACGGTAGAGCAGTAGACTCTTAATCTATTGGTTGCG  
 GGTTCAAATCCCTCGTCACCCA



>640697113 tRNA-Trp-CCA [Anabaena sp. PCC 7120: NC\_003272] (+)strand  
CATCTGCCGCTAGTTACCTCGACAAAACCTATGGTAGAATGGTAATCTAGT  
TACGTTAGACTAAAAAAGTTTGACATAAACTAAAATCAAGCCAGCTTGT  
GCGCTCTTAGTTCAGTTGGTAGAACGCAGGTCTCCAAAACCTGATGTCGG  
GGGTTCAAGTCCTCCAGGGCGCG

>640697114 tRNA-Cys-GCA [Anabaena sp. PCC 7120: NC\_003272] (-)strand  
TCACTATGCTTTGAAAACCTCCACTAGCAATAGCAAATTTTTGCAACTTG  
GGGATGCAAAACAAAGCAAACCTATGCTATGATAGTTGACTGTAGAGTGC  
GGCGGCATAGCCAAGTGGTAAGGCAGAGGTCTGCAAACCTCCATCCCCC  
GGTTCAAATCCGGGTGCCGCCT