



## **Appendices**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
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## APPENDIX A

### Nucleotide sequences and genbank accession numbers of *Tropilaelaps mercedesae* collected from honey bees in Northern Thailand

#### *Tropilaelaps mercedesae* samples from Chapter 3

LOCUS KP774527 573 bp DNA linear INV 09-FEB-2015

DEFINITION *Tropilaelaps mercedesae* isolate CM7 18S ribosomal RNA gene, partial sequence.

ACCESSION KP774527

VERSION

KEYWORDS

SOURCE *Tropilaelaps mercedesae*

ORGANISM *Tropilaelaps mercedesae*  
Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
Laelapidae; *Tropilaelaps*.

REFERENCE 1 (bases 1 to 573)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
and KHONGPHINITBUNJONG, K.

TITLE *Apis dorsata* F. comb structure and *Tropilaelaps* infestation

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 573)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
and KHONGPHINITBUNJONG, K.

TITLE Direct Submission

JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
Thailand

FEATURES Location/Qualifiers

source 1..573  
/organism="*Tropilaelaps mercedesae*"  
/mol\_type="genomic DNA"  
/isolation\_source="*Apis dorsata* comb"  
/host="*Apis dorsata*"  
/db\_xref="taxon:418985"  
/sex="Female"  
/lab\_host="Bee Protection Laboratory"  
/country="THAILAND"  
/collection\_date="22-Jan-2012"  
/collected\_by="Ninat Buawangpong"  
/identified\_by="Jakkrawut Maitip"

rRNA <1..573  
/product="18S ribosomal RNA"

BASE COUNT 175 a 138 c 114 g 146 t

ORIGIN

1 cgcccactt gatttcagat acacgtcaaa gttgagcagg cagcatcaact ctcgtgaccg  
61 tggagatttt ataccattgc gtagcggcaa tagtaagtac atatactacg agttatatac  
121 tgaacaagt gtagcataga cacaaggcat ccatgctgaa attttcattc aaaaacacaa  
181 tgctcacaaa atttcacaac tcacatcaat ttcacaaat tacaatgttt tcatcgatt  
241 taaggactaa gtgatcccc atattgagtc ctgatgcgtt tttttttct ccatagcacg  
301 agttaaattgg aaaagcatgt caaacggac gcaccggcga cgcgcgecta acttcacagc  
361 cgaagtcaga tcgcaatagc aatggaatac atacgatact gggcacagat gcctctcccg  
421 tccgcctccg cggagagggt tagaacatca ttcgagcacc actcgctcgc cgacggagtg  
481 aatggacttt gcgacagtaa tgatcctcc gcaggttcac ctacggaaac cttgtttaat  
541 tttttctta caaaaaaaaaa ggggaaatta ggg

LOCUS KP774528 505 bp DNA linear INV 09-FEB-2015  
 DEFINITION *Tropilaelaps mercedesae* isolate CM8 18S ribosomal RNA gene,  
 partial sequence.  
 ACCESSION KP774528  
 VERSION  
 KEYWORDS  
 SOURCE *Tropilaelaps mercedesae*  
 ORGANISM *Tropilaelaps mercedesae*  
 Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
 Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
 Laelapidae; *Tropilaelaps*.  
 REFERENCE 1 (bases 1 to 505)  
 AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
 and KHONGPHINITBUNJONG, K.  
 TITLE *Apis dorsata* F. comb structure and *Tropilaelaps* infestation  
 JOURNAL Unpublished  
 REFERENCE 2 (bases 1 to 505)  
 AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
 and KHONGPHINITBUNJONG, K.  
 TITLE Direct Submission  
 JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
 University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
 Thailand  
 FEATURES Location/Qualifiers  
 source 1..505  
 /organism="*Tropilaelaps mercedesae*"  
 /mol\_type="genomic DNA"  
 /isolation\_source="*Apis dorsata* comb"  
 /host="*Apis dorsata*"  
 /db\_xref="taxon:418985"  
 /sex="Female"

/lab\_host="Bee Protection Laboratory"

/country="THAILAND"

/collection\_date="22-Jan-2012"

/collected\_by="Ninat Buawangpong"

/identified\_by="Jakkrawut Maitip"

rRNA <1..505

/product="18S ribosomal RNA"

BASE COUNT 152 a 127 c 102 g 124 t

ORIGIN

1 aagttgagca ggcagcatca ctctcgtgac cgtggagatt ttataccatt gcgtagcggc  
61 aatagtaagt acatatacta cgagttatat actgaaacaa gtgtagcata gacacaaggc  
121 atccatgctg aaatttcat tcaaaaacac aatgctcaca aaattcaca actcacatca  
181 atttcacaa attacaatgt tttcatcga ttaaggact aagtgatccc ccatattgag  
241 tctgatgcg tttttttt ctccatagca cgagttaa at ggaaaagcat gtcaaaccgg  
301 acgcaccggc gacgcgcgcc taactcaca gccgaagtca gatcgcaata cgaatggaat  
361 acatacgata ctgggcacag atgcctctcc cgtcgcctc cgcggagagg gttagaacat  
421 cattcgagca ccactcgtc gccgacggag tgaatggact ttgcgacagt aatgatcctt  
481 ccgcaggttc acctacggaa acctt

LOCUS KP774529 465 bp DNA linear INV 09-FEB-2015

DEFINITION *Tropilaelaps mercedesae* isolate CM9 18S ribosomal RNA gene,  
partial sequence.

ACCESSION KP774529

VERSION

KEYWORDS

SOURCE *Tropilaelaps mercedesae*

ORGANISM *Tropilaelaps mercedesae*  
Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
Laelapidae; *Tropilaelaps*.

REFERENCE 1 (bases 1 to 465)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
and KHONGPHINITBUNJONG, K.

TITLE *Apis dorsata* F. comb structure and *Tropilaelaps* infestation

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 465)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
and KHONGPHINITBUNJONG, K.

TITLE Direct Submission

JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
Thailand

FEATURES Location/Qualifiers

source 1..465  
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/mol\_type="genomic DNA"  
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/host="*Apis dorsata*"  
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/sex="Female"

/lab\_host="Bee Protection Laboratory"

/country="THAILAND"

/collection\_date="22-Jan-2012"

/collected\_by="Ninat Buawangpong"

/identified\_by="Jakkrawut Maitip"

rRNA <1..465

/product="18S ribosomal RNA"

BASE COUNT 141 a 115 c 97 g 112 t

ORIGIN

1 gttgagcagg cagcatcact ctcgtgaccg tggagatttt ataccattgc gtagcggcaa  
61 tagtaagtac atatactacg agttatatac tgaacaagt gtagcataga cacaaggcat  
121 ccatgctgaa atttcattc aaaaacaaa tgctcaaaa attcacaac tcacatcaat  
181 ttccacaat tacaatgttt ttcacgatt taaggactaa gtgatecccc atattgagtc  
241 ctgatgCGTT ttttttct ccatagcagc agttaatgg aaaagcatgt caaacggac  
301 gcaccggcga cgcgcgcta acttcacagc cgaagtcaga tcgcaatagc aatggaatac  
361 atacgatact gggcacagat gcctctccg tccgctccg cggagagggt taaaaagcgt  
421 tcgagcacca ctcgctgcc gacggagtga atggacttgc gacag

LOCUS KP774522 524 bp DNA linear INV 09-FEB-2015  
 DEFINITION *Tropilaelaps mercedesae* isolate CM6 18S ribosomal RNA gene,  
 partial sequence.  
 ACCESSION KP774522  
 VERSION  
 KEYWORDS  
 SOURCE *Tropilaelaps mercedesae*  
 ORGANISM *Tropilaelaps mercedesae*  
 Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
 Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
 Laelapidae; *Tropilaelaps*.  
 REFERENCE 1 (bases 1 to 524)  
 AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
 and KHONGPHINITBUNJONG, K.  
 TITLE *Apis dorsata* F. comb structure and *Tropilaelaps* infestation  
 JOURNAL Unpublished  
 REFERENCE 2 (bases 1 to 524)  
 AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.  
 and KHONGPHINITBUNJONG, K.  
 TITLE Direct Submission  
 JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
 University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
 Thailand  
 FEATURES Location/Qualifiers  
 source 1..524  
 /organism="*Tropilaelaps mercedesae*"  
 /mol\_type="genomic DNA"  
 /isolation\_source="*Apis dorsata* comb"  
 /host="*Apis dorsata*"  
 /db\_xref="taxon:418985"  
 /sex="Female"



/lab\_host="Bee Protection Laboratory"

/country="THAILAND"

/collection\_date="22-Jan-2012"

/collected\_by="Ninat Buawangpong"

/identified\_by="Jakkrawut Maitip"

rRNA <1..524

/product="18S ribosomal RNA"

BASE COUNT 157 a 131 c 105 g 131 t

ORIGIN

1 ttgattcag atacacgtca agttgagcag gcagcatcac tctcgtgacc gtggagattt  
61 tatacattg cgtageggca atagtaagta catatactac gagttatata ctgaaacaag  
121 tgtagcatag acacaaggca tccatgctga aatttcatt caaaacaca atgctcaaa  
181 aatttcaaa ctcacatcaa ttccacaaa ttacaatggt ttcatcgat ttaaggacta  
241 agtgatcccc catattgagt cctgatgcgt tttttttc tccatagcac gagttaaag  
301 gaaaagcatg tcaaaccgga cgcaccggcg acgcgcgct aacttcacag ccgaagtcag  
361 atcgcaatac gaatggaata catacgatac tgggcacaga tgctctccc gtccgctcc  
421 gcggagaggg ttagaacatc attcgagcac cactcgctcg ccgacggagt gaatggactt  
481 tgcgacagta atgatcctc cgcaggttca cctacggaaa cctt

***Tropilaelaps mercedesae* samples from Chapter 4**

LOCUS KP774523 552 bp DNA linear INV 09-FEB-2015

DEFINITION *Tropilaelaps mercedesae* isolate CM2 18S ribosomal RNA gene,  
partial sequence.

ACCESSION KP774523

VERSION

KEYWORDS

SOURCE *Tropilaelaps mercedesae*

ORGANISM *Tropilaelaps mercedesae*

Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
Laelapidae; *Tropilaelaps*.

REFERENCE 1 (bases 1 to 552)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Seasonal abundance and interspecific competition between *Varroa* and  
*Tropilaelaps* mites when infesting *Apis mellifera*

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 552)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Direct Submission

JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
Thailand

FEATURES Location/Qualifiers

source 1..552

/organism="*Tropilaelaps mercedesae*"

/mol\_type="genomic DNA"

/isolation\_source="*Apis mellifera* comb"

/host="Apis mellifera"  
/db\_xref="taxon:418985"  
/sex="Female"  
/lab\_host="Bee Protection Laboratory"  
/country="THAILAND"  
/collection\_date="8-SEP-2011"  
/collected\_by="Ninat Buawangpong"  
/identified\_by="Jakkrawut Maitip"

rRNA

<1..552

/product="18S ribosomal RNA"

BASE COUNT 140 a 113 c 137 g 162 t

ORIGIN

1 aacaaggttt ccgtaggtga acctcggaa ggatcattac tgcgcaaag tccattcaact  
61 ccgtcggcga gcgagtggg ctcgaatgat gttctaacc tctccgcgga ggcggacggg  
121 agaggcatct gtgcccagta tcgtatgtat tccattcgta ttgcgatctg acttcggctg  
181 tgaagttagg cgcgcgtcgc cggcgcgtcc ggtttgacat gctttccat ttaactcgtg  
241 ctatggagaa aaaaaaacg catcaggact caatatgggg gatcacttag tcctaaatc  
301 gatgaaaaac attgtaattt gtggaaattg atgtgagttg tgaattttg tgagcattgt  
361 gttttgaaat gaaaattca gcatggatgc cttgtgtcta tgctacactt gtttcagtat  
421 ataactcgta gtatatgtac ttactattgc cgctacgcaa tggataaaa tctccacggt  
481 cacgaaagtg atgctgcctg ctcaactga cgtgtatctg aatcaagtg tgacgaccg  
541 ctgaacttaa gc

LOCUS KP774524 545 bp DNA linear INV 09-FEB-2015

DEFINITION *Tropilaelaps mercedesae* isolate CM3 18S ribosomal RNA gene,  
partial sequence.

ACCESSION KP774524

VERSION

KEYWORDS

SOURCE *Tropilaelaps mercedesae*

ORGANISM *Tropilaelaps mercedesae*  
Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
Laelapidae; *Tropilaelaps*.

REFERENCE 1 (bases 1 to 545)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Seasonal abundance and interspecific competition between *Varroa* and  
*Tropilaelaps* mites when infesting *Apis mellifera*

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 545)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Direct Submission

JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
Thailand

FEATURES Location/Qualifiers

source 1..545  
/organism="*Tropilaelaps mercedesae*"  
/mol\_type="genomic DNA"  
/isolation\_source="*Apis mellifera* comb"  
/host="*Apis mellifera*"  
/db\_xref="taxon:418985"

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/sex="Female"
/lab_host="Bee Protection Laboratory"
/country="THAILAND"
/collection_date="8-SEP-2011"
/collected_by="Ninat Buawangpong"
/identified_by="Jakkrawut Maitip"
rRNA <1..545
/product="18S ribosomal RNA"
BASE COUNT 160 a 140 c 112 g 133 t
ORIGIN
1 aagttcaggg ggtcgcccca ctgattca gatccagcc aagttgagca ggcagcatca
61 ctctctgac cgtggagatt ttataccatt gcgtagcggc aatagtaagt acatatacta
121 cgagttatat actgaaacaa gtgtagcata gacacaaggc atccatgctg aaattttcat
181 tcaaaaacac aatgctcaca aaattcaca actcacatca attccacaa attacaatgt
241 ttttcacga ttaaggact aagtgatccc ccatattgag tctgatgcg tttttttt
301 ctccatagca cgagttaaat ggaaaagcat gtcaaaccgg acgcaccggc gacgcgcgcc
361 taactcaca gccgaagtca gatcgcaata cgaatggaat acatacgata ctgggcacag
421 atgctctcc cgtccgctc cgcggagagg gttagaacat cattcgagca ccaactgctc
481 gccgacggag tgaatggact ttgcgacagt aatgatcctt ccgcaggtc acctacggaa
541 acctt

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LOCUS KP774525 550 bp DNA linear INV 09-FEB-2015  
 DEFINITION *Tropilaelaps mercedesae* isolate CM4 18S ribosomal RNA gene,  
 partial sequence.  
 ACCESSION KP774525  
 VERSION  
 KEYWORDS  
 SOURCE *Tropilaelaps mercedesae*  
 ORGANISM *Tropilaelaps mercedesae*  
 Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
 Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
 Laelapidae; *Tropilaelaps*.  
 REFERENCE 1 (bases 1 to 550)  
 AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
 KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.  
 TITLE Seasonal abundance and interspecific competition between *Varroa* and  
*Tropilaelaps* mites when infesting *Apis mellifera*  
 JOURNAL Unpublished  
 REFERENCE 2 (bases 1 to 550)  
 AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
 KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.  
 TITLE Direct Submission  
 JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
 University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
 Thailand  
 FEATURES Location/Qualifiers  
 source 1..550  
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/sex="Female"  
/lab\_host="Bee Protection Laboratory"  
/country="THAILAND"  
/collection\_date="8-SEP-2011"  
/collected\_by="Ninat Buawangpong"  
/identified\_by="Jakkrawut Maitip"

rRNA

<1..550  
/product="18S ribosomal RNA"

BASE COUNT 165 a 136 c 112 g 137 t

ORIGIN

1 gatatgctta agttcagcgg gtcgtcacac ttgattcag atacagtca agttgagcag  
61 gcagcatcac tctcgtgacc gtggagattt tataccattg cgtagcggca atagtaagta  
121 catatactac gagttatata ctgaaacaag ttagcatag acacaaggca tccatgctga  
181 aatttcatt caaaaacaca atgctcacia aatttcacia ctcacatcaa ttccacaaa  
241 ttacaatggt tttcatcgat ttaaggacta agtgatcccc catattgagt cctgatgcgt  
301 ttttttttc tccatagcac gagttaaag gaaaagcatg tcaaaccgga cgcaccggcg  
361 acgcgcgcct aacttcacag ccgaagtcag atcgcaatac gaatggaata catacgatac  
421 tgggcacaga tgcctctccc gtccgcctcc gcggagaggg ttaaaacatc attcgagcac  
481 cactcgctcg ccgacggagt gaatggactt tgcgacagta atgaccttc cgcaggttca  
541 cctacggaaa

LOCUS KP774526 544 bp DNA linear INV 09-FEB-2015

DEFINITION *Tropilaelaps mercedesae* isolate CM5 18S ribosomal RNA gene,  
partial sequence.

ACCESSION KP774526

VERSION

KEYWORDS

SOURCE *Tropilaelaps mercedesae*

ORGANISM *Tropilaelaps mercedesae*  
Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
Laelapidae; *Tropilaelaps*.

REFERENCE 1 (bases 1 to 544)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Seasonal abundance and interspecific competition between *Varroa* and  
*Tropilaelaps* mites when infesting *Apis mellifera*

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 544)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Direct Submission

JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
Thailand

FEATURES Location/Qualifiers

source 1..544  
/organism="*Tropilaelaps mercedesae*"  
/mol\_type="genomic DNA"  
/isolation\_source="*Apis mellifera* comb"  
/host="*Apis mellifera*"  
/db\_xref="taxon:418985" 98



/sex="Female"  
/lab\_host="Bee Protection Laboratory"  
/country="THAILAND"  
/collection\_date="8-SEP-2011"  
/collected\_by="Ninat Buawangpong"  
/identified\_by="Jakkrawut Maitip"  
rRNA <1..544  
/product="18S ribosomal RNA"

BASE COUNT 160 a 139 c 111 g 134 t

ORIGIN

1 taagttcagc gggtcgtccc acttgatttc agatccacgt caagttgagc aggcagcadc  
61 actctcgtga ccgtggagat ttataccat tgcgtagcgg caatagtaag tacatatact  
121 acgagttata tactgaaaca agtgtagcat agacacaagg catccatgct gaaatttca  
181 tcaaaaaca caatgetcac aaaattcac aactcacatc aattccaca aattacaatg  
241 ttttcatcg atttaaggac taagtgatcc cccatattga gtctgatgc gttttttt  
301 tctccatagc acgagttaa tggaaaagca tgcataaccg gacgcaccgg cgacgcgcgc  
361 ctaactcac agccgaagtc agatcgcaat acgaatggaa tacatacgat actgggcaca  
421 gatgcctctc ccgtccgect ccgaggagag ggtagaaca tcattcgagc accactcget  
481 cgccgacgga gtgaatggac ttgcgacag taatgatcct tccgcaggtt cacctacgga  
541 aacc

LOCUS KP774521 501 bp DNA linear INV 09-FEB-2015

DEFINITION *Tropilaelaps mercedesae* isolate CM1 18S ribosomal RNA gene,  
partial sequence.

ACCESSION KP774521

VERSION

KEYWORDS

SOURCE *Tropilaelaps mercedesae*

ORGANISM *Tropilaelaps mercedesae*  
Eukaryota; Metazoa; Ecdysozoa; Arthropoda; Chelicerata; Arachnida;  
Acari; Parasitiformes; Mesostigmata; Dermanyssina; Dermanyssoidea;  
Laelapidae; *Tropilaelaps*.

REFERENCE 1 (bases 1 to 501)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Seasonal abundance and interspecific competition between *Varroa* and  
*Tropilaelaps* mites when infesting *Apis mellifera*

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 501)

AUTHORS BUAWANGPONG, N., CHANTAWANNAKUL, P., BURGETT, M.,  
KHONGPHINITBUNJONG, K., de GUZMAN, L.I. and FRAKE, A.M.

TITLE Direct Submission

JOURNAL Submitted (09-FEB-2015) Department of Biology, Chiang Mai  
University, Huay Kaew Road, Chiang Mai, Muang District 50200,  
Thailand

FEATURES Location/Qualifiers

source 1..501  
/organism="*Tropilaelaps mercedesae*"  
/mol\_type="genomic DNA"  
/isolation\_source="*Apis mellifera* comb"  
/host="*Apis mellifera*"  
/db\_xref="taxon:418985" 100

/sex="Female"  
/country="THAILAND"  
/collection\_date="8-SEP-2011"  
/collected\_by="Ninat Buawangpong"  
/identified\_by="Jakkrawut Maitip"

rRNA

<1..>501

/product="18S ribosomal RNA"

BASE COUNT 150 a 127 c 101 g 123 t

ORIGIN

1 ttgagcaggc agcatcactc tcgtgaccgt ggagatttta taccattgcg tagcggcaat  
61 agtaagtaca tatactacga gttatatact gaaacaagtg tagcatagac acaaggcatc  
121 catgctgaaa ttttcattca aaaacacaat gctcacaaaa ttcacaact cacatcaatt  
181 tccacaaatt acaatgtttt tcatcgattt aaggactaag tgatccceca tattgagtcc  
241 tgatgcggtt tttttctc catagcacga gttaatgga aaagcatgtc aaaccggacg  
301 caccggcgac gcgcgctaa cttcacagcc gaagtcagat cgcaatacga atggaataca  
361 tacgatactg ggacacagatg cctctcccgt cgcctcccgc ggagaggggtt agaacatcat  
421 tcgagcacca ctcgctcgcc gacggagtga atggacttgg cgacagtaat gatccttccg  
481 caggttcacc tacggaaacc t



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## APPENDIX B

### Nucleotide sequences of *Varroa destructor* and *Varroa jacobsoni* collected from honey bees in Northern Thailand

#### Sample 1 - *V. destructor* K1

ACAAAGAGGGAAGAAGCAGCCTTTTGGAAATTTAGGGATAATTTACGCT  
ATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTCATCATATATTTAC  
AGTAGGAATAGATATTGATACTCGAGCATATTTACTGCAGCTACAATAATT  
ATTGCGGTTCCCTACTGGTATTAATAATTTTTCTTGATTAGCAACAATTCATGG  
TTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTTAGGTTTTATTTTT  
TATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTAATT

#### Sample 2 - *V. destructor* K1

TGTAATTTGTATACAAAGAGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTAATAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTAGCTA  
ATTCTTCTATTGATATTG

#### Sample 3 - *V. destructor* K1

TGTAATTTGTATACAAAGAGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTAATAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 4 - *V. destructor* K1**

TGTAATTTGTAAACAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTA  
ATTCTTTATTTGATATTG

**Sample 5 - *V. destructor* K1**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 6 - *V. destructor* K1**

CATGTAATTTATTATCAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAG  
GGATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGAGC  
TCATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACT  
GCAGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATT  
AGCAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCT  
TTAGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGC  
TAATTCTTCTATTGATATTGA

**Sample 7 - *V. destructor* K1**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGC  
TCATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACT  
GCAGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATT  
AGCAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCT  
TTAGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGC  
TAATTCTTCTATTGATATTG

**Sample 8 - *V. destructor* K1**

TGTAATTTGTAAACAAAGAGGGGAAGAAGCAGCCTTTTGGAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGAATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 9 - *V. destructor* K1**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 10 - *V. destructor* K1**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 11 - *V. jacobsoni* NThai**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGAGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTACTGC  
AGCTACAATAATTATTGCGGTTCCCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 12 - *V. jacobsoni* NThai**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGAGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACTGC  
AGCTACAATAATTATTGCGGTTCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 13 - *V. destructor* K1**

TGTAATTTGTATACAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACTGC  
AGCTACAATAATTATTGCGGTTCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 14 - *V. destructor* K1**

TGTAATTTGTAAACAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGG  
ATAATTTACGCTATAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTC  
ATCATATATTTACAGTAGGAATAGATATTGATACTCGAGCATATTTTACTGC  
AGCTACAATAATTATTGCGGTTCTACTGGTATTA AAAATTTTTCTTGATTAG  
CAACAATTCATGGTTCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTT  
AGGTTTTATTTTTTTATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTA  
ATTCTTCTATTGATATTG

**Sample 15 - *V. destructor* K1**

CAAAGAGGGGAAGAAGCAGCCTTTTGGAAATTTAGGGATAATTTACGCTA  
TAATAACTATCGGTATTTTAGGTTTTATTGTATGGGCTCATCATATATTTACA  
GTAGGAATAGATATTGATACTCGAGCATATTTTACTGCAGCTACAATAATTA  
TTGCGGTTCTACTGGTATTA AAAATTTTTCTTGATTAGCAACAATTCATGGT  
TCTATAGTTAAATTAGATGTCCCGATAATTTGATCTTTAGGTTTTATTTTTTT  
ATTTACTTTAGGGGGTATTACTGGTGTAATTTTAGCTAATTCTTCTATTGATA  
TTG

**Sample 16 - *V. jacobsoni* NThai**

**TGTAATTTGTATACAAAGAGGGAAAAAGCAACCTTTTGGTAATTTAGGG  
ATAATTTATGCTATAATAACTATTGGTATTTTAGGTTTTATTGTATGAGCTC  
ATCATATATTTACAGTAGGTATAGATATTGATACTCGGGCTTATTTTACTGC  
GGCTACAATGATTATTGCGGTTCCCCTGGTATTAATAATTTTTCTTGACTA  
GCTACAATTCATGGTTCTATAGTAAAATTAGATGTTCCAATAATCTGATCTT  
TGGGATTTATTTTTTTATTTACTTTGGGGGGAATTACTGGTGTGATTTTAGCT  
AATTCTTCTATTGATATTG**

**Sample 17 - *V. jacobsoni* NThai**

**TGTAATTTGTATACAAAGAGGGAAAAAGCAACCTTTTGGTAATTTAGGG  
ATAATTTATGCTATAATAACTATTGGTATTTTAGGTTTTATTGTATGAGCTC  
ATCATATATTTACAGTAGGTATAGATATTGATACTCGGGCTTATTTTACTGC  
GGCTACAATGATTATTGCGGTTCCCCTGGTATTAATAATTTTTCTTGACTA  
GCTACAATTCATGGTTCTATAGTAAAATTAGATGTTCCAATAATCTGATCTT  
TGGGATTTATTTTTTTATTTACTTTGGGGGGAATTACTGGTGTGATTTTAGCT  
AATTCTTCTATTGATATTG**

**Sample 18 - *V. jacobsoni* NThai**

**TGTAATTTGTATACAAAGAGGGAAAAAGCAACCTTTTGGTAATTTAGGG  
ATAATTTATGCTATAATAACTATTGGTATTTTAGGTTTTATTGTATGAGCTCA  
TCATATATTTACAGTAGGTATAGATATTGATACTCGGGCTTATTTTACTGCG  
GCTACAATGATTATTGCGGTTCCCCTGGTATTAATAATTTTTCTTGACTAGC  
TACAATTCATGGTTCTATAGTAAAATTAGATGTTCCAATAATCTGATCTTTG  
GGATTTATTTTTTTATTTACTTTGGGGGGAATTACTGGTGTGATTTTAGCTAA  
TTCTTCTATTGATATTG**

**Sample 19 - *V. jacobsoni* NThai**

**TGTAATTTGTATACAAAGAGGGAAAAAGCAACCTTTTGGTAATTTAGGG  
ATAATTTATGCTATAATAACTATTGGTATTTTAGGTTTTATTGTATGAGCTC  
ATCATATATTTACAGTAGGTATAGATATTGATACTCGGGCTTATTTTACTGC  
GGCTACAATGATTATTGCGGTTCCCCTGGTATTAATAATTTTTCTTGACTA  
GCTACAATTCATGGTTCTATAGTAAAATTAGATGTTCCAATAATCTGATCTT  
TGGGATTTATTTTTTTATTTACTTTGGGGGGAATTACTGGTGTGATTTTAGCT  
AATTCTTCTATTGATATTG**



**Sample 20 - *V. jacobsoni* NThai**

**TGTAATTTGTATACAAAGAGGGAAAAAGCAACCTTTTGGTAATTTAGGG  
ATAATTTATGCTATAATAACTATTGGTATTTTAGGTTTTATTGTATGAGCTCA  
TCATATATTTACAGTAGGTATAGATATTGATACTCGGGCTTATTTTACTGCG  
GCTACAATGATTATTGCGGTTCCCACTGGTATTAATAATTTTTCTTGACTAGC  
TACAATTCATGGTTCTATAGTAAAATTAGATGTTCCAATAATCTGATCTTTG  
GGATTTATTTTTTTTATTTACTTTGGGGGAATTACTGGTGTGATTTTAGCTAA  
TTCTTCTATTGATATTG**



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## CURRICULUM VITAE

- Name** Miss Ninat Buawangpong
- Date of Birth** October 19<sup>th</sup>, 1984
- Place of Birth** Chiang Mai Province, Thailand
- Education** 2011-Present Ph.D. student in Biology, Department of Biology,  
Faculty of Science, Chiang Mai University,  
Thailand
- 2006-2008 Mater of Science, Department of Entomology,  
Faculty of Agriculture, Chiang Mai University,  
Thailand
- 2002-2005 Bachelor of Science, Department of Entomology,  
Faculty of Agriculture, Chiang Mai University,  
Thailand
- Publications:**
1. **Buawangpong, N.**, Sukumalanand, P, Burgett, M., “*Apis florea* drone flight: longevity and flight performance,” *Apidologie*, 2008, DOI: 10.1051/apido:2008059.
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