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## Appendix

### Appendix I: List of putative lipocalins obtained from hard ticks

Gene accession code	Species	name	Expression	Function	Ligand	Reference
196476629	<i>Amblyomma americanum</i>	Lipocalin	Salivary gland (Adult female)	Not determined	Not determined	Aljamali, NCBI direct submission 2008 Aljamali <i>et al.</i> , 2009
45360102	<i>Boophilus microplus</i> ( <i>Rhipicephalus microplus</i> )	Lipocalin-like protein (BmLipo)	Salivary gland	Not determined	Not determined	Azzolini, NCBI direct submission
51011424	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011558	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011480	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011422	<i>Ixodes pacificus</i>	Truncated secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011604	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011586	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011498	<i>Ixodes pacificus</i>	Truncated secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011532	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011410	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
51011416	<i>Ixodes pacificus</i>	Putative secreted histamine binding protein	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> ,2005
160423587	<i>Ixodes ricinus</i>	IR24H	Salivary gland	Not determined	Not determined	Chmelař <i>et al.</i> ,2008
160423404	<i>Ixodes ricinus</i>	IR4D	Salivary gland	Not determined	Not determined	Chmelař <i>et al.</i> ,2008
160423666	<i>Ixodes ricinus</i>	IR7D	Salivary gland	Not determined	Not determined	Chmelař <i>et al.</i> ,2008
219935266	<i>Ixodes ricinus</i>	LIR1	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935268	<i>Ixodes ricinus</i>	LIR2	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935270	<i>Ixodes ricinus</i>	LIR3	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935272	<i>Ixodes ricinus</i>	LIR4	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935274	<i>Ixodes ricinus</i>	LIR5	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935278	<i>Ixodes ricinus</i>	LIR7	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935280	<i>Ixodes ricinus</i>	LIR8	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935284	<i>Ixodes ricinus</i>	LIR9	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935288	<i>Ixodes ricinus</i>	LIR10	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935290	<i>Ixodes ricinus</i>	LIR11	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935292	<i>Ixodes ricinus</i>	LIR12	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935294	<i>Ixodes ricinus</i>	LIR13	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
219935296	<i>Ixodes ricinus</i>	LIR14	Salivary gland	Not determined	Not determined	Beaufays <i>et al.</i> ,2008a
22164270	<i>Ixodes scapularis</i>	IXOSC	Salivary gland	Not determined	Not determined	Ribeiro <i>et al.</i> ,2006
22164268	<i>Ixodes scapularis</i>	IXOSC	Salivary gland	Not determined	Not determined	Ribeiro <i>et al.</i> ,2006
67083743	<i>Ixodes scapularis</i>	IXOSC	Salivary gland	Not determined	Not determined	Ribeiro <i>et al.</i> ,2006
67083682	<i>Ixodes scapularis</i>	IXOSC	Salivary gland	Not determined	Not determined	Ribeiro <i>et al.</i> ,2006
67083741	<i>Ixodes scapularis</i>	IXOSC	Salivary gland	Not determined	Not determined	Ribeiro <i>et al.</i> ,2006



## Appendix II: List of putative lipocalins obtained from soft ticks

Gene accession code	Species	name	Expression	Function	Ligand	Reference
114153299	<i>Argas monolakensis</i>	AM-1124	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153281	<i>Argas monolakensis</i>	AM-925	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153165	<i>Argas monolakensis</i>	AM-304	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153123	<i>Argas monolakensis</i>	AM-249	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153089	<i>Argas monolakensis</i>	AM-209	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153071	<i>Argas monolakensis</i>	AM-194	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153281	<i>Argas monolakensis</i>	AM-925	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153053	<i>Argas monolakensis</i>	AM-180	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114153035	<i>Argas monolakensis</i>	AM-118	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152997	<i>Argas monolakensis</i>	AM-53	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152995	<i>Argas monolakensis</i>	AM-51	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152993	<i>Argas monolakensis</i>	AM-50	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152989	<i>Argas monolakensis</i>	AM-47	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152981	<i>Argas monolakensis</i>	AM-41	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152959	<i>Argas monolakensis</i>	AM-26B	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
114152957	<i>Argas monolakensis</i>	AM-26A	Salivary gland (Adult female)	Not determined	Not determined	Mans <i>et al.</i> , 2008a
172051078	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-15)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051154	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-43)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051146	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-41)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051090	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-2)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051116	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-3)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051210	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-62)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051236	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-80)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051084	<i>Ornithodoros coriaceus</i>	Moubatin-like lipocalin (OC-169)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051218	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-677)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051166	<i>Ornithodoros coriaceus</i>	Salivary secreted lipocalin (OC-477)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051204	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-6)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051222	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-7)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051234	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-8)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b
172051114	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-29)	Salivary gland	Not determined	Not determined	Fracischetti <i>et al.</i> , 2008b



172051112	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-28)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008b
172051206	<i>Ornithodoros coriaceus</i>	Moubatin-like lipocalin (OC-60)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008b
172051168	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-481)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008b
172051062	<i>Ornithodoros coriaceus</i>	Salivary lipocalin (OC-128)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008b
149287076	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-468)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149286978	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-168)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287102	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-509)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149286916	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-113)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287038	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-316)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287088	<i>Ornithodoros parkeri</i>	Salivary secreted lipocalin (OP-49)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287092	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-49a)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287008	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-24)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287084	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-485)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149286896	<i>Ornithodoros parkeri</i>	Moubatin homologue 1 (OP-1)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287032	<i>Ornithodoros parkeri</i>	Short salivary moubatin (OP-30)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149286962	<i>Ornithodoros parkeri</i>	Moubatin homologue 6 (OP-15)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149286972	<i>Ornithodoros parkeri</i>	Salivary lipocalin (OP-16)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287118	<i>Ornithodoros parkeri</i>	Moubatin homologue 5 variant (OP-55a)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287116	<i>Ornithodoros parkeri</i>	Moubatin homologue 5 (OP-55)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287000	<i>Ornithodoros parkeri</i>	Moubatin 1 homolog 2 (OP-2)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
147287126	<i>Ornithodoros parkeri</i>	Moubatin homolog 4 (OP-6)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287112	<i>Ornithodoros parkeri</i>	Salivary secreted lipocalin (OP-540)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149287170	<i>Ornithodoros parkeri</i>	Moubatin homolog 7 (OP-88)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
149286990	<i>Ornithodoros parkeri</i>	Truncated salivary lipocalin (OP-177)	Salivary gland	Not determined	Not determined	Francischetti <i>et al.</i> , 2008a
29779506	<i>Ornithodoros porcinus porcinus</i>	-	Total ticks	Not determined	Not determined	Neilan, 2003 NCBI direct submission



### Appendix III: Overview of AMPs from soft ticks

Tick species	AMP name	Primary tissue source (s)	Antimicrobial activity			References	Genebank Accession code
			G+	G-	Fungi		
<i>A. monolakensis</i>	AM-135	SG	N/D	N/D	N/D	Mans <i>et al.</i> , 2008a	114153040
<i>A. monolakensis</i>	AM-383	SG	N/D	N/D	N/D	Mans <i>et al.</i> , 2008a	114153200
<i>A. monolakensis</i>	AM-1173	SG	N/D	N/D	N/D	Mans <i>et al.</i> , 2008a	114153302
<i>A. monolakensis</i>	AM-1246	SG	N/D	N/D	N/D	Mans <i>et al.</i> , 2008a	114153306
<i>A. monolakensis</i>	AM-189	SG	N/D	N/D	N/D	Mans <i>et al.</i> , 2008a	114153066
<i>O. coriaceus</i>	OC-32	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008b	172051122
<i>O. coriaceus</i>	OC-31	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008b	172051120
<i>O. coriaceus</i>	OC-33	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008b	172051124
<i>O. coriaceus</i>	OC-696	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008b	172051220
<i>O. coriaceus</i>	OC-487	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008b	172051172
<i>O. parkeri</i>	OP-104	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008a	149286902
<i>O. parkeri</i>	OP-129	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008a	149286938
<i>O. parkeri</i>	OP-New-613	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008a	149287206
<i>O. parkeri</i>	OP-336	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2008a	149287050
<i>O. savignyi</i>	Fraction 50%	HL	+	-	N/D	Unpublished	Unpublished
<i>O. savignyi</i>	Fraction 30%	SG	+	+	N/D	Unpublished	Unpublished

**+**: Activity present

**-**: Activity absent

**N/D**: Not determined

**SG**: Salivary gland

**HL**: Hemolymph



#### Appendix IV: Overview of AMPs from hard ticks

Tick species	AMP name	Primary tissue source (s)	Antimicrobial activity			References	Genebank Accession code
			G+	G-	Fungi		
<i>A. americanum</i>	Amercin	HC	N/D	N/D	N/D	Todd <i>et al.</i> , 2007	114438982
<i>I. pacificus</i>	Neuropeptide-like protein (nlp-31)	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2005	51011444
<i>I. pacificus</i>	Neuropeptide-like protein (nlp-31)	SG	N/D	N/D	N/D	Francischetti <i>et al.</i> , 2005	51011404
<i>I. ricinus</i>	Contig 921	SG	N/D	N/D	N/D	Chmelař <i>et al.</i> , 2008	160423978
<i>I. ricinus</i>	Contig 969	SG	N/D	N/D	N/D	Chmelař <i>et al.</i> , 2008	160424079
<i>I. ricinus</i>	Contig 279	SG	N/D	N/D	N/D	Chmelař <i>et al.</i> , 2008	
<i>I. ricinus</i>	Contig 494	SG	N/D	N/D	N/D	Chmelař <i>et al.</i> , 2008	
<i>I. ricinus</i>	Contig 935	SG	N/D	N/D	N/D	Chmelař <i>et al.</i> , 2008	
<i>I. scapularis</i>	56159955	SG	N/D	N/D	N/D	Ribeiro <i>et al.</i> , 2006	56159955
<i>I. scapularis</i>	56159959	SG	N/D	N/D	N/D	Ribeiro <i>et al.</i> , 2006	56159959
<i>I. scapularis</i>	IS-18-24-clu340	SG	N/D	N/D	N/D	Ribeiro <i>et al.</i> , 2006	67083170
<i>I. scapularis</i>	ISJ-ISPL_P10_H6	SG	N/D	N/D	N/D	Ribeiro <i>et al.</i> , 2006	67083433
<i>I. scapularis</i>	50363174	SG	N/D	N/D	N/D	Ribeiro <i>et al.</i> , 2006	50363174

**N/D: Not determined**  
**HC: Hemocytes**  
**SG: Salivary gland**



## Appendix V: *De novo* sequence results of active fraction

Hit	Score <sup>a</sup>	Accession number	Peptide sequence <sup>b</sup>	Protein name <sup>c</sup>
1	71	46447343	682 LMZYTPMELR 691	Hypothetical protein.//:sptrembl Q6MAG6 Q6MAG6_PARUW. Hypothetical protein.//:trembl BX908798 BX908798_1709 product: "unknown protein"; Parachlamydia-related symbiont UWE25, complete genome
2	68		529 YALSPNALFPR 539	AgCP1586 (Fragment)
3	64	44355455	732 ETDYFFNZRZE 742	"unknown"; Environmental sequence IBEA_CTG_2107665, whole genome shotgun sequence.
4	64	29747767	859 EDYFFNZR 866	"4921510J17Rik protein"; Mus musculus RIKEN cDNA 4921510J17 gene, mRNA (cDNA clone MGC:58741 IMAGE:6770929), complete cds.
5	64	51859290	859 EDYFFNZR 866	"Unknown (protein for MGC:93934)"; <i>Rattus norvegicus</i> cDNA clone MGC:93934 IMAGE:7113453, complete cds
6	63	259683019	753 ETDYFFNZN 760	"Hypothetical protein CBG20942"; <i>Caenorhabditis briggsae</i> contig cb25.fpc4206 from assembly cb25.agp8
7	63	24636146	753 ETDYFFNZN 760	Serpentine receptor, class e (epsilon) protein 52"; <i>Caenorhabditis elegans</i> cosmid C50E10, complete sequence.
8	63	24636146	753 ETDYFFNZN 760	"Hypothetical protein C50E10.5"; <i>Caenorhabditis elegans</i> cosmid C50E10, complete sequence. //:pironly T33499 T33499 hypothetical protein C50E10.5 - <i>Caenorhabditis elegans</i> //:gp AF098988 14916287. Hypothetical protein C50E10.5 [ <i>Caenorhabditis elegans</i> ]
9	59	15042158	899 SSFZRFFN 906	"048R"; <i>Chilo iridescent virus</i> complete genome. //:gp AF303741 15042201 048R [ <i>Chilo iridescent virus</i> ]

<sup>a</sup> Score (high scoring pair, HSP) as determined by BLAST, using sequences obtained from *de novo* sequencing. Matches higher than 64 are considered significant

<sup>b</sup> Peptide sequence of the *de novo* data. The numbers give the residues to which the query sequence matched to the protein sequence in the database

<sup>c</sup> Identity of the proteins to which the *de novo* sequences were matched