

# Curriculum vitae Dr. Ir. Niels O. Verhulst

## Personalia

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Last name:	Verhulst	Telephone:	+41523383713
First name:	Niels	E-mail:	Niels.Verhulst@uzh.ch
Address:	Winterthurerstr. 266A 8057 Zurich Switzerland	Date of birth:	29 May 1979
		Nationality:	Dutch

## Professional experience and internships

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- 11/2017-  
Present Post-doc researcher at the National Centre of Vector Entomology, University of Zurich, Switzerland  
The Vector Entomology unit has a broad research spectrum on various aspects of arthropod vectors  
The lab acts as the Swiss National Centre for Vector Entomology (NZVE), as appointed by the  
Swiss Federal Food Safety and Veterinary Office. Through its activities, the center plays a central  
role in the early recognition of vector- borne epizootics and zoonoses and provides expertise for the  
identification of arthropod vectors in Switzerland. The NZVE engages in teaching as well as  
consulting for other institutions active in the field of vector entomology. I focus on the behavioral  
aspects of vectors-host interactions and the pathogens transmitted.
- 4/2014-  
10/2017 Post-doc researcher at the Laboratory of Entomology at the Wageningen University, Wageningen,  
The Netherlands.  
*Project: Mosquitoes as bridge vectors of infectious pathogens between apes and humans.*  
A personal NWO-Veni grant to determine which mosquitoes bite both humans and apes and  
thereby may be bridge vectors of infectious diseases. Volatile and microbiota composition of both  
apes and humans were determined, compared and tested for attraction to mosquitoes. In Cameroon  
and The Republic of Congo mosquitoes were sampled near wild primates.
- 11/2010-  
4/2014 Post-doc researcher at the Laboratory of Entomology at the Wageningen University, Wageningen,  
The Netherlands.  
*Project: Skin microbiota as determinant of host specificity in mosquitoes.*  
Determine host preference of various mosquito species and determine the role of bacterial volatiles  
in mosquito host-seeking behavior. Supervision of Junior Researcher, Annette Busula, ICIPE, Mbita,  
Kenya
- 10/2010 Centre National de Recherche et de Formation sur le Paludisme, Ouagadougou, Burkina Faso  
Field work to study the ecology of a newly-discovered malaria mosquito species – Invited by Ken  
Vernick, Pasteur Institute, France.
- 9/2006–  
9/2010 PhD-student at the Laboratory of Entomology at the Wageningen University, Wageningen, The  
Netherlands  
*Project: Behavioral response of Anopheles gambiae to human odors and the role of skin microbiota.*  
In my PhD thesis, I showed that the human skin bacterial composition influences a person's  
attractiveness to mosquitoes. The bacteria involved and the volatiles they produced were identified  
and tested as a synthetic blend in Kenya.
- 2/2006-  
8/2006 Junior researcher at the Laboratory of Entomology at the Wageningen University, Wageningen, The  
Netherlands  
*Project: Distribution and population dynamics of arthropod vectors of infectious diseases in The  
Netherlands. A risk analysis on the dispersal of vector diseases with a focus on Bluetongue.*  
Potential disease vectors were sampled at twelve locations in The Netherlands. Temperature and  
humidity were monitored and the possible effects of climate change investigated.
- 7/2005-  
1/2006 Researcher at Tropenzorg B.V. and guest employee at Wageningen University, The Netherlands  
*Project: Registration of biocidal products of Tropenzorg under the new European Union Biocide  
Directive.*
- 12/2004  
6/2005 Reviewer phytosanitary law, Netherlands Food and Consumer Product Safety Authority,  
Wageningen, The Netherlands  
*Project: Translation of the Dutch Phytosanitary law into a database for companies involved in  
international transportation of plants.*
- 8/2003- Field researcher, Instituut voor Rationele Suikerproductie (IRS), Bergen op Zoom, The Netherlands

12/2003

5/2003-7/2003 Researcher, Laboratory of Entomology, Wageningen University, Wageningen, The Netherlands  
*Project: Sampling and identification by PCR of Anopheles mosquitoes in the province of Zuid-Holland and blood meal identification with the ELISA method.*

1999-2003 Internships, Laboratory of Entomology, Wageningen University, The Netherlands/ Costa Rica  
*Project 3: Blood meal identification in Anopheles maculipennis s.l. by ELISA*  
*Project 2: Development of a method to determine the age of Encarsia formosa s.l. in its natural habitat in Costa Rica*  
*Project 1: Distinguish two parasitoid wasps by PCR and sequencing*

## Education & Courses

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1997-2003 Plant Breeding and Crop Protection, specialization Ecological Crop Protection, Wageningen University, Wageningen, The Netherlands  
1991-1997 Secondary education, VWO, Haarlemmermeerlyceum, Hoofddorp  
Courses: Introduction to R, Communicating with children: Learning by investigation, New Frontiers in Microbiology, Multivariate Data Analysis Basic Course, Umetrics, Statistical analysis of ~omics data, Wageningen University, Advanced statistics, Wageningen University, Basic statistics, Wageningen University, Insect Chemical Ecology, Alnarp Sweden

## Awards

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2015 3<sup>rd</sup> prize MoBio Microbiome award for sequencing primate skin bacteria (\$2000)  
2012 Verhulst et al. 2011 PLoS One highlighted as: “One of the most influential papers of 2012 on tropical medicine and malaria”  
2011 1<sup>st</sup> prize best talk at the International Symposium on Chemical Ecology: Reception, Detection and Deception” of the Royal Entomological Society, Greenwich, UK  
2010 1<sup>st</sup> prize PE&RC best publication award for the article: Verhulst et al. 2010. FEMS Microb. Ecol., 74:1-9 (€1000)  
2009 3<sup>rd</sup> prize best presentation, ISCE meeting, Neuchatel, Switzerland  
2008 3<sup>rd</sup> prize best poster award, NERN meeting, Lunteren, The Netherlands

## Grants

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### Project grants

2017 NWO-ALW grant for a four-year PhD project entitled: The smell of success: Detection of nutritious blood meals by mosquitoes (**€268,614**)  
2013 NWO-Veni grant for a three-year post-doc project entitled: Mosquitoes as bridge vectors of infectious pathogens between apes and humans (**€ 250,000**).  
2010 NWO-ALW grant for a three-year post-doc project with the title: Skin microbiota as determinant of host specificity in mosquitoes (**€ 250,000**).

### Travel grants

2011 Uyttenboogaart-Eliassen Stichting travel fund for the International Symposium on Chemical Ecology: Reception, Detection and Deception” Greenwich, UK  
2009 Uyttenboogaart-Eliassen Stichting travel fund for SOVE conference, Turkey  
2009 ISCE Travel award, ISCE meeting, Neuchatel, Switzerland  
2008 PE&RC travel fund, field work, Kenya  
2007 LEB travel fund, Young Investigator Meeting, Tanzania  
2006 ECRO Student Fellowship, Course Insect Chemical Ecology, Alnarp, Sweden

## Presentations

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### International meetings

2017 Dutch trade mission with Dutch minister of agriculture, UC Davis, USA, **Invited speaker**  
2016 European Society of Vector Ecology (ESOVE), Lisbon, Portugal  
2015 International Society of Chemical Ecology (ISCE), Stockholm, Sweden, **Invited speaker**  
2014 Latin American Society of Chemical Ecology (ALAEQ), Bogota, Colombia. **Keynote speaker**  
2012 International Society of Chemical Ecology (ISCE), Vilnius, Lithuania **Invited speaker**  
2012 Annual meeting of the American Society of Tropical Medicine and Hygiene (ASTMH), Atlanta, USA  
2011 International Symposium Chemical Ecology (ISCE): Reception, Detection and Deception, Greenwich, UK.

2009 Society of Vector Ecology (SOVE), Antalya, Turkey.  
2009 International Society of Chemical Ecology (ISCE), Neuchatel, Switzerland.

#### National conferences

2017 Amsterdam Kindersymposium, Amsterdam, **Invited speaker**  
2017 Netherlands Annual Ecology Meeting, Lunteren  
2009 Cultured skin microbiota attract malaria mosquitoes, Dutch Entomology Society (NEV), Ede  
2007 Structural design affects entry response of mosquitoes in olfactometers. NEV, Ede.

#### Poster presentations

2012 Identification of mosquito attractants using skin bacterial odors. Annual meeting of the American Society of tropical Medicine and Hygiene, Atlanta, USA  
2010 Skin microbiota attracts malaria mosquitoes – Keystone Symposium, Malaria: New Approaches to Understanding Host-Parasite Interactions, Copper Mountain, CO, USA.  
2009 Attractiveness of human skin bacteria to the malaria mosquito *Anopheles gambiae* in a laboratory, semi-field and field setup – Netherlands Annual Ecology Meeting, Lunteren, the Netherlands.

#### Organization/chair of symposia, sessions or meetings

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2012 Symposium organizer “The influence of microorganisms on the behavior of disease vectors” Annual meeting of the American Society of tropical Medicine and Hygiene, Atlanta, USA  
2011 Symposium organizer “Chemical ecology of microorganisms, including symbionts and pathogens of plants and animals; soil microorganisms” at the 27<sup>th</sup> Annual Meeting of the International Society of Chemical Ecology, Vancouver, Canada.  
2011 Session organizer: “Microbiological Entomology”. Annual meeting of the Laboratory of Entomology  
2009 Session chair (2x) 5<sup>th</sup> International SOVE Congress, Antalya, Turkey (2009)  
2009 Session chair Dutch Entomology Society meeting, Ede (2009)  
2008 Organizer Young Investigators Meeting GCGH #121, Wageningen, The Netherlands

#### Teaching/ supervising PhD, MSc and BSc students

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2013-2017 Supervision of PhD student Annette O. Busula: Microorganism-mediated behaviour of malaria mosquitoes  
2007-2017 Direct supervision of >15 MSc-students during their major thesis  
2011-2017 Direct supervision of >10 BSc-students during their bachelor thesis  
2013-2017 Lecturer in the course “Analysis and Prevention of Tropical Health Risks”  
2010-2017 Setup and teaching the practical course Frontiers in Medical and Veterinary Biology  
2013 Guest speaker, Leids Universitair Medisch Centrum, Entomological aspects of malaria  
2006 Teaching assistant in the courses: Molecular and Evolutionary Entomology, Ecological aspects of bio-interactions, Ecology I & 2

#### Non-scientific publications/ outreach

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Invited speaker: “Kennis op Zondag” organized by NWO to inform the general public about current scientific research. ([www.youtube.com/watch?v=NUZLUKMQVV0](http://www.youtube.com/watch?v=NUZLUKMQVV0))  
Newspapers: NRC, De Volkskrant, Trouw, De Telegraaf, Algemeen Dagblad and several local newspapers.  
Radio: NOS Journaal, Noorderlicht, Labyrint, de Wereldomroep and several others.  
Television: NOS Journaal, NOS Journaal op drie, Noorderlicht, BBC world, several others  
(<http://rockhopper.tv/films/detail/smelly-feet-fighting-malaria>)  
(<http://www.uitzendinggemist.nl/afleveringen/1357189>)  
Other: Promotion new research proposal:  
[https://www.youtube.com/watch?v=lhz\\_LT3nl0s&index=4&list=PLpDaNIQ8d5b42i\\_7dPV7h7a6xJMEYS-z](https://www.youtube.com/watch?v=lhz_LT3nl0s&index=4&list=PLpDaNIQ8d5b42i_7dPV7h7a6xJMEYS-z)

#### Reviewer/ Examiner

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Examiner: 2017, PhD examiner, Peter Christ, SLU, Sweden  
2015, PhD Upgrading Christina Due, London School of Hygiene & Tropical Medicine  
Grants: Reviewer Medical Research Council (UK), Parasitic diseases  
Journal Science, Ecological Entomology, Entomologische Berichten, Journal of Vector Ecology, Global  
reviewer: Research Journal of Agricultural and Biological Sciences, Malaria Journal, Parasites & Vectors, Journal of Parasitology and Vector Biology, Journal of Insect Physiology, Current Opinion Insect Science, Environmental Science and Pollution Research

## Additional information:

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Languages: Dutch: native speaker, English: fluent, German: good, French: basic, Spanish: basic  
Computer: Endnote, Adobe Photoshop, SPSS, Genstat, , R-programming, Xcalibur (GC-MS analysis), SIMCA-P (multivariate analysis)  
Other skills: Experience in bio-assays, field work (The Netherlands, Burkina Faso, Costa Rica, Cameroon, Republic of Congo, Kenya, Tanzania), mosquito rearing, GC-MS analysis, various molecular techniques (PCR, ELISA, RLB)

## Publications

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### *International (refereed) journals.*

Busula, A. O., Verhulst, N. O., Bousema, T., Takken, W. & de Boer, J. G. (2017) Mechanisms of *Plasmodium*-enhanced attraction of mosquito vectors. **Trends in Parasitology**, 33, 961-973.

Takken, W. and **Verhulst N.O.**, Chemical signaling in mosquito-host interactions: the role of human skin microbiota. (2017) **Current Opinion in Insect Science.**, 20, 68-74

Busula, A.O., Bousema, T., Mweresa, C.K., Masiga, D., Logan, J.G., Sauerwein, R.W., **Verhulst, N.O.**, Takken, W., de Boer, J.G., (2017). Gametocytemia and attractiveness of *Plasmodium falciparum*-infected Kenyan children to *Anopheles gambiae* mosquitoes. **The Journal of Infectious Diseases** 216, 291-295.

Busula, A.O., W. Takken, J.G.d. Boer, W.R. Mukabana, **Verhulst, N.O.**, (2017) Variation in host preference of malaria mosquitoes is mediated by skin bacterial volatiles. **Medical and Veterinary Entomology**, 31, 320-326.

Junker, R.R., Kuppler J., Amo L., Blande J.D., Borges R.M., van Dam N.M., . . . **Verhulst, N.O.** . . . T.G. Köllner, Covariation and phenotypic integration in chemical communication displays: biosynthetic constraints and eco-evolutionary implications. **New Phytologist.**, 2017: p. Early online.

**Verhulst, N. O.**, Weldegergis B.T., Menger D., Takken W. (2016) Attractiveness of volatiles from different body parts to the malaria mosquito *Anopheles coluzzii* is affected by deodorant compounds. **Scientific reports**, 6:27141.

Takken W., van Vliet A. J. H., **Verhulst, N. O.**, Jacobs F. H. H., Gassner F., Hartemink N., Mulder S., Sprong H. (2016) Acarological risk of *Borrelia burgdorferi* sensu lato infections across space and time in The Netherlands. **Vector-Borne and Zoonotic Diseases**, 17:99-107.

**Verhulst NO**, Bakker J.W., Hiscox A.: Modification of the suna trap for improved survival and quality of mosquitoes in support of epidemiological studies. (2015) **Journal of the American Mosquito Control Association**, 31:223-232.

van Loon J.J.A., Smallegange R.C., Bukovinszkiné-Kiss G., Jacobs F., De Rijk M., Mukabana W.R., **Verhulst N.O.**, Menger D.J., Takken W. (2015) Mosquito attraction: crucial role of carbon dioxide in formulation of a five-component blend of human-derived volatiles. **Journal of Chemical Ecology**, 41:567-573.

Mweresa C.K., Otieno B., Omusula P., Weldegergis B.T., Verhulst N.O., Dicke M., van Loon J.J.A., Takken W., Mukabana W.R. (2015) Understanding the long-lasting attraction of malaria mosquitoes to odor baits. **PLoS ONE**, 10:e

Busula A., Takken W., Loy D., Hahn B., Mukabana W., **Verhulst N.O.** (2015) Mosquito host preferences affect their response to synthetic and natural odour blends. **Malaria Journal**, 14:133.

Pombi M., Jacobs F., **Verhulst N.O.**, Caputo B., della Torre A., Takken W. (2014) Field evaluation of a novel synthetic odour blend and of the synergistic role of carbon dioxide for sampling host-seeking *Aedes albopictus* adults in Rome, Italy. **Parasites & Vectors**, 7:580.

**Verhulst, N.O.**, J. A. C. M. Loonen, W. Takken. (2013). Advances in methods for colour marking of mosquitoes. **Parasites & Vectors**. 6: 200.

**Verhulst, N. O.**, H. Beijleveld, Y. T. Qiu, C. Maliepaard, W. Verduyn, G. W. Haasnoot, F. H. J. Claas, R. Mumm, H. J. Bouwmeester, W. Takken, J. J. A. van Loon, and R. C. Smallegange. (2013) Relation between HLA genes, human skin volatiles and attractiveness of humans to malaria mosquitoes. **Infection, Genetics and Evolution**. 18: 87-93

Takken, W. and **N.O. Verhulst**. (2013) Host preferences of blood-feeding mosquitoes. **Annual Review of Entomology**. 58:433–53.

**Verhulst, N. O.**, R. C. Smallegange, and W. Takken. (2012) Mosquitoes as potential bridge vectors of malaria parasites from non-human primates to humans. *Frontiers in Physiology* 3: 197.

**Verhulst, N.O.**, Y.T.Qiu, H. Beijleveld, C. Maliepaard, D. Knights, S. Schulz, D. Berg-Lyons, C.L. Lauber et al. (2011) Composition of human skin microbiota affects attractiveness to malaria mosquitoes. **PLoS One** 6(12): e28991. *PLoS One* “One of the most influential papers of 2011 on tropical medicine and malaria”

**Verhulst, N.O.**, P.A. Mbadi, G. Bukovinszkiné Kiss, W.R. Mukabana, J.J.A. van Loon, W. Takken and R.C. Smallegange. (2011) Improvement of a synthetic lure for *Anopheles gambiae* using compounds produced by human skin microbiota. **Malaria Journal**. 10:28.

Smallegange, R.C., **N.O. Verhulst** and W. Takken. (2011) Sweaty skin: an invitation to bite? **Trends in Parasitology**. 27: 143-148.

Gassner, F., W. Takken, A. Van Vliet, S. Burgers, F.H.H. Jacobs, P. Verbaarschot, M. Hovius, S. Mulder, **N.O. Verhulst** and van L. Overbeek. (2011) Geographic variation in population dynamics of *Ixodes ricinus* and associated *Borrelia* infections in the Netherlands. **Vector-Borne and Zoonotic Diseases**. 11: 523-532.

**Verhulst, N.O.**, W.R. Mukabana, W. Takken and R.C. Smallegange. (2011) Human skin microbiota and their volatiles as odour baits for the malaria mosquito *Anopheles gambiae* s.s. **Entomologia Experimentalis et Applicata**. 139: 170-179.

**Verhulst, N.O.**, R. Andriessen, U. Groenhagen, G. Bukovinszkiné Kiss, S. Schulz, W. Takken, J.J.A. van Loon, G. Schraa and R.C. Smallegange. (2010) Differential attraction to malaria mosquitoes of volatile blends produced by human skin bacteria. **PLoS One**. 5(12):e15829.

Smallegange, R.C., W.H. Schmied, K.J. van Roey, **N.O. Verhulst**, J. Spitzen, W.R. Mukabana, and W. Takken. (2010) Sugar-fermenting yeast as an organic source of carbon dioxide to attract the malaria mosquito *Anopheles gambiae* s.s. **Malaria Journal**. 9:292. *Malaria Journal* “Highly accessed”

**Verhulst, N.O.**, W. Takken, M. Dicke, G. Schraa and R.C. Smallegange. (2010) Chemical ecology of interactions between human skin microbiota and mosquitoes. **FEMS Microbiology Ecology**, 74:1-9.

**Verhulst, N.O.**, H. Beijleveld, B.G.J. Knols, W. Takken, G. Schraa, H.J. Bouwmeester and R.C. Smallegange. 2009. Cultured skin microbiota attract malaria mosquitoes. **Malaria Journal**, 8:302. *Malaria Journal* “Highly accessed”

Takken, W., **N.O. Verhulst**, E.J. Scholte, F. Jacobs, Y. Jongema, and R. van Lammeren. 2008. The phenology and population dynamics of *Culicoides* spp. in different ecosystems in The Netherlands. **Preventive Veterinary Medicine** 87: 41-54.

#### *Books and book contributions*

**Verhulst, N.O.**, Spitzen, J., Boulanger, N., 2018. Impact of skin microbiome on attractiveness to arthropod vectors and pathogen transmission, in: Boulanger, N. (Ed.), *Skin and Arthropods*. Academic Press, London, pp. 55-82.

**Verhulst, N.O.** and W. Takken. Skin microbiota and attractiveness to mosquitoes, pp. 591-595, *In* N.E. Karen [eds], *Encyclopedia of Metagenomics*, Springer.

**Verhulst, N.O.** (2010). The role of skin microbiota in the attractiveness of humans to the malaria mosquito *Anopheles gambiae* Giles, PhD thesis, pp. 236, Entomology. Wageningen University, Wageningen, The Netherlands.

**Verhulst, N.O.**, C.F. Curtis and N. Hill. (2007). Personal protection against European disease vectors, pp. 355-368. *In* W. Takken and B. Knols [eds.], *Emerging Pests and Vector-borne Diseases in Europe*. Wageningen Academic Publishers, Wageningen, The Netherlands.

Takken, W., E.M.A. van Rooij, **N.O. Verhulst**, F. Jacobs, S. Huijben, J. Beeuwkes, N. Groot, V.C.A. Vos, J. Spitzen, R.C.G. Heutink and P.A. van Rijn. (2007). Bluetongue: an emerging vector-borne disease outbreak

in North-western Europe, pp. 113-121. *In* W. Takken and B. Knols [eds.], *Emerging Pests and Vector-borne Diseases in Europe*. Wageningen Academic Publishers, Wageningen, The Netherlands.

*Other*

**Verhulst, N.O.**, W. Takken and R.C. Smallegange. 2008. Structural design affects entry response of mosquitoes in olfactometers. *Proceedings of the Section Experimental and Applied Entomology of the Netherlands Entomological Society (NEV)* 19: 129-135.

Takken, W., **N.O. Verhulst**, E.J. Scholte, F.H.H. Jacobs, Y. Jongema, R.J.A. van Lammeren, A.R. Bergsma, T.C. Klok, H.J.W. van Roermund, A.A. de Koeijer and F.H.M. Borgsteede. 2007. Distribution and dynamics of arthropod vectors of zoonotic disease in the Netherlands in relation to risk of disease transmission, pp. 59. Wageningen University.