Proceedings of the Eleventh International Conference on Urban Pests 2025
AF-Borgen, Academic Society, Lund, Sweden
William H Robinson, editor

PROJECT ORGANIZATION THAT PROMOTES THE USE OF NEW KNOWLEDGE IN PEST CONTROL

[1]ANDERS AAK, [1]BJØRN ARNE RUKKE, [1]MARI STEINERT, [1]MORTEN HAGE, [2]ØYVIND MAGERØY, [2]RAGNA BYRKJELAND, AND [2]MAREN TRONES CHRISTIANSEN
[1] Department of Pest Control, Norwegian Institute of Public Health, Norway
[2] Norsk Hussopp Forsikring, Norway

Abstract It is often challenging to communicate research results and convince different stakeholders to use new control methods. When Norway experienced an "invasion" of the nuisance pest *Ctenolepisma longicaudatum*, lack of knowledge and massive media attention escalated the societal response towards extreme fear of a mostly harmless insect. To quell this new pest situation, we established a collaboration project involving government institutions, most of the Norwegian pest control companies (suppliers), and the insurance industry (purchasers). Solution requirements were mapped from both the purchaser and the supplier point of view, and the connection to both parties was carefully maintained throughout the project. Research aims shifted during the course of the project and were always adjusted in collaboration between all stakeholders. Because all participants had influence over research questions and the project progression, their ownership to the results was strengthened. This promoted dissemination of the findings, and new poisoned baits strategies were deployed nationwide without any delay. This project points at key elements in successful development and application of new pest control strategies. By involving all stakeholders, the participants' role was lifted from a state of secrecy to a more active contest for provision of insight into practical solutions and challenges. The project structure also created a race among pest control companies for deliverance of the new and optimized strategies into the marked.

Key words Innovation, development, application, poisonous bait, *Ctenolepisma longicaudatum*

INTRODUCTION

Innovation and the application of new methods or technology are important for the progression of the pest control industry, and research within the field of pest control is useful when moving towards more efficient and safer strategies. Historically, it is probable that too much of the indoor pest control effort has relied on the traditional use of sprayable neurotoxic pesticides (Dhang 2011). The general eradication effect, ease of use, availability to the public, tradition within **P**est **C**ontrol **C**ompanies (PCC), the habits among **P**est **C**ontrol **T**echnicians (PCT), and a recurrent lack of scientifically documented effects from alternative approaches are likely to have combined to create a strong unbalance towards pesticide use. Pesticides are surely efficient in controlling insect problems, but strong reliance on them also promote resistance issues which in turn may promote further use and stronger concentrations of active ingredients (Radcliffe et al. 2008, Dhang 2011, 2014, Zhu et al. 2016). Problematic issues with exposure to various chemicals in the indoor environment are constantly put forth in relation to hazardous substances used in building materials and consumer products (Wigle et al. 2007, Sakhi et al. 2019), but when it comes to indoor use of pesticides the bar for acceptance is surprisingly low. Pesticides constitute a major hazard for humans, and in particular for children (Bonnefoy et al. 2008, Kim et al. 2017, Rani et al. 2021). Indoor pest control therefore needs to consider and evaluate the consequences for users of the building.

New urban or indoor pest issues may arise either because of invasive species, regulation of control methods or pesticides, societal changes such as trade and travel, constructional alterations of the urban environment, or from climate change (Robinson 2005, Hulme et al. 2008, Banks et al. 2015, Dawson et al. 2017, Padayachee et al. 2017, Pergl et al. 2017). If new areas are made available for the pests, they may thrive and consequently create an issue through their sheer numbers or through their damage potential. When new problems appear, or known pests show up in new regions, there is an opportunity to approach the issue with a new focus that subsequently may allow development of more successful and safer strategies. This was the situation in Norway when *Ctenolepisma longicaudatum* (Zygentoma, Lepismatidae) suddenly appeared and rapidly became established as a nuisance pest (Aak et al. 2019, Aak et al. 2021). Even though *C. longicaudatum* has been known as an indoor pest species from several parts of the world for more than 100 years (Womersley 1937, Lindsay 1940, Mallis 1941), efficient and safe control measures have not been described. This new indoor pest spreading rapidly throughout Norway created a media frenzy which got completely out of hand. At its peak, we observed one media-case for every fourth infestation (Aak et al. 2021). At the time of the invasion, the number of scientific publications regarding *C. longicaudatum* was limited, and the certainty of control success was therefore low. This fueled the *C. longicaudatum* media frenzy further, and we saw excessive use of pesticides, management efforts without any known effects, advise on mitigating measures without any support in observations, and most importantly, multiple court cases where purchasers of infested apartments received large compensations from the sellers. This nuisance pest therefore started to tie up societal resources and have a strong impact on multiple stakeholders like building constructors, housing associations, insurance companies, merchandise distributors, and trade organizations.

The silverfish issue and its societal impact had to be resolved, and the new situation presented an opportunity to deploy the entire management system in Norway. When approaching new issues within pest control, it is necessary to have both a practical and a scientific focus (Buczkowski 2014). A sound balance between theory and pest control practice is likely to establish trust between research institutions and the users of the new knowledge. In this paper, we describe the Norwegian management system and its balance between science and application, the system's benefit in terms of knowledge building and dissemination, and we show how a multi-stakeholder approach helped to create ownership to the solutions within the pest control companies, which subsequently allowed rapid deployment of the new strategy.

MATERIALS AND METHODS

The Norwegian pest management system is governed through the pest management regulation (Ministry of Health and Care Services 2000), which intends to prevent pests from causing harm through the spread of diseases, material damage, mental distress, or deterioration of the environment. The regulation also requires that pest management professionals are educated and approved by the government and conduct their control efforts in a way that relies on knowledge, are efficient, and at the same time conducted in a way that safeguards the environment and the public health. The Ministry of Health and Care Services is responsible for the legislation and regulation of pest management. It uses the Norwegian Directorate of Health (NDH - department of environmental health) for the formal approval of PCTs, and the Norwegian Institute of Public Health (NIPH - department of pest control) as their pest control advisors, teachers, and knowledge foundation. This creates a direct link between the Norwegian pest control association (SKABRA), PCCs and their PCTs, and the government officials.

In this pest management setting, we established a nation-wide and multi-stakeholder project (Figure 1) to identify and deploy an efficient and safe control strategy for handling of the *C. longicaudatum* issue. The project was scientifically grounded in the department of pest control, NIPH, and intended to involve a major part of the pest control professionals in Norway. Broad participation from PCCs was necessary to obtain and refine knowledge and experience in

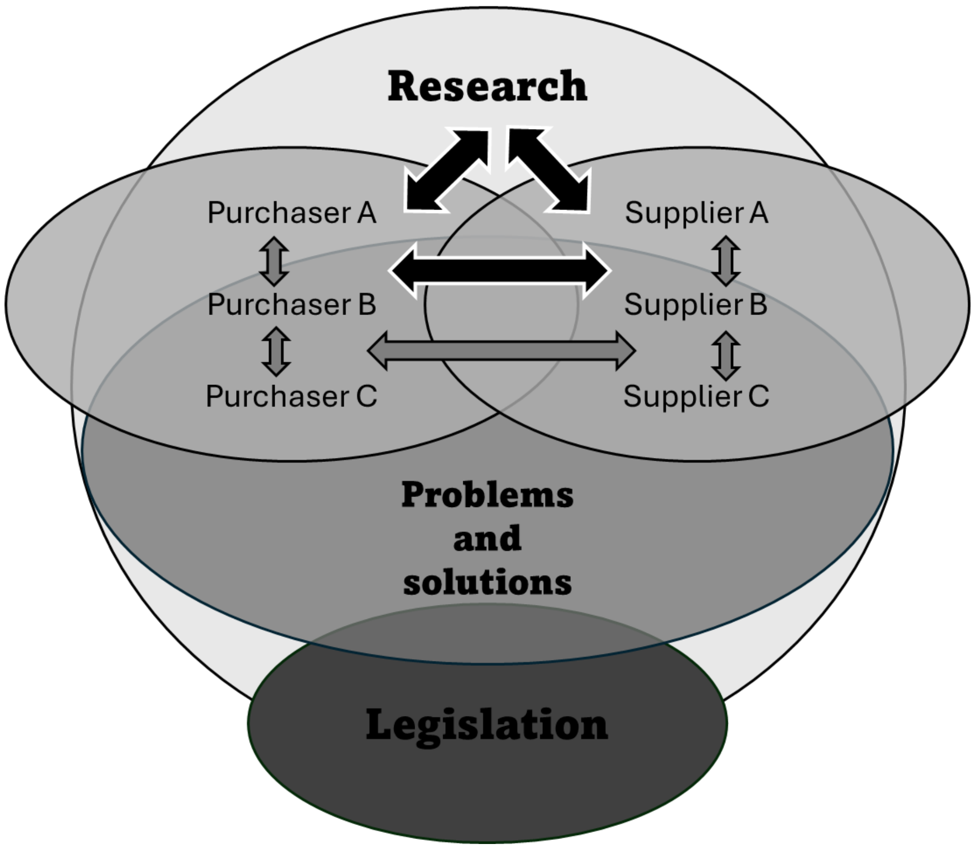

Figure 1 Illustration of the project structure used to identify problems and find solutions to the *Ctenolepisma longicaudatum* problem in Norway. The foundation is research and legislation, and the venture is structured as an applied knowledge-building project. The figure indicates common interest between multiple stakeholders in collaboration (overlapping circles), and the formalized collaboration (black arrows) aims to support both purchasers and suppliers. Grey arrows indicate purchasers and suppliers in a coopetititon situation.

the pest control industry and to ensure wide acceptance of the potential solutions obtained through the research. The Norwegian Environment Agency was involved by virtue of their regulatory function for pesticides and their task of safeguarding both the indoor and outdoor environment. The project was initiated and financed by the NIPH and Norsk Hussopp Forsikring (NHF); a non-profit insurance company owned by the insurance holders (approximately 60% of Norwegians with pest control as a part of their home contents insurance). The inclusion of the insurance industry ensured participation of a large proportion of the Norwegian customer base for the pest management companies. The constellation of government officials (knowledge and regulation) working together with both pest management professionals (suppliers) and insurance companies (purchasers) provided initial input from all parts with an interest in a solution and allowed identification of the knowledge gaps. Formally, the project was established as a national knowledge building project, and it consisted of an administration steering committee (NIPH and NHF), a subject group consisting of NIPH, NHF, 4-5 subject managers from the main pest control companies (representing >70% of the pest control industry), selected pest control technicians with firsthand silverfish control experience, and a procurement officer from one of the main Norwegian house owners (BBY Oslo). Scientific literature on *C. longicaudatum* was compiled (Aak et al. 2019) and published in both Norwegian and English to supply an up-to-date knowledge foundation. The project aims and progression plans were developed and directed in collaboration by the entire subject group throughout the project. NIPH supplied the media and non-participating stakeholders with continuous information and updates, and the basic information strategy was to disseminate new findings and results as soon and as broadly as possible.

The main research aims of the initial project were to 1) review the scientific literature and 2) evaluate different control methods according to both control effect and cost efficiency. The studies quickly highlighted bait as the safest and most suitable method, which could be accepted within the legislation boundaries of the pest control act. It is the most suitable control method with a strong population decimation, and toxic baits often yield only a minor contamination of the indoor environment (Dhang 2011, 2016, Wang et al. 2019). The research aims were therefore adjusted towards a bait strategy with focus on efficacy of different baits and cost-efficient approaches for the practical use of bait by technicians.

RESULTS

C. longicaudatum started to get media attention in 2014, and the first formal description of the new problem was published the same year (Mattsson 2014). In retrospect, a few cases from as early as 2004, 2006, 2008, and 2009, have been found (Aak et al. 2021), and PCTs can recall several early infestations at the time believed to be the common silverfish (*Lepisma saccharinum*), that they failed to control (*pers. comm. E. Roligheten*). The new issue continued to increase in 2015, and the Norwegian Institute of Public health included *C. longicaudatum* in the pest control statistics in 2016 (Figure 2). The extent of the silverfish problem continued to increase throughout the country in 2016 and 2017, and reached an all-county distribution in 2018 (Aak et al. 2021).

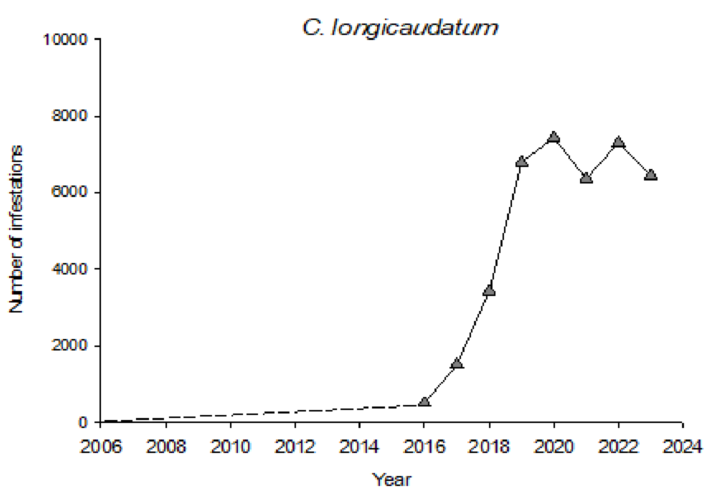

Figure 2. Number of *Ctenolepisma longicaudatum* infestations in Norway over years (2006-2023). The values represent control cases reported by the majority of pest control companies, and the dotted line represents an estimation based on a limited number of observations collected in retrospect.

Initial field investigations. Trapping with sticky-traps, spray treatment (permethrin), and bait (indoxacarb) were initially compared in 29 apartments with the same level of infestation within the same apartment complex (Aak et al. 2020b). Within the 10 weeks of the experiment, trapping with 0.5 traps/m^2 provided a limited control effect only and was considered highly impractical by the apartment owners. Spray treatment and bait reduced the populations by 53% and 76%, respectively. With this knowledge at hand, Norwegian legislation defines bait as the preferred method through the principle of substitution (desired effect at the lowest possible risk), and bait consequently became the focus of the research.

Laboratory testing of baits. Testing of different bait products with different active ingredients available to the Norwegian pest control industry revealed that indoxacarb supplied both primary and secondary poisoning of *C. longicaudatum* (Figure 3 and (Aak et al. 2020a)). Laboratory studies also revealed that bait with low concentrations was equally effective and even better for secondary poisoning, that removal of competing food sources was a key element combined with the time available for bait consumption, and that the bait effect could be improved by distributing many small droplets of bait along the walls of a room (Aak et al. 2020b, Aak et al. 2020a, Rukke et al. 2021).

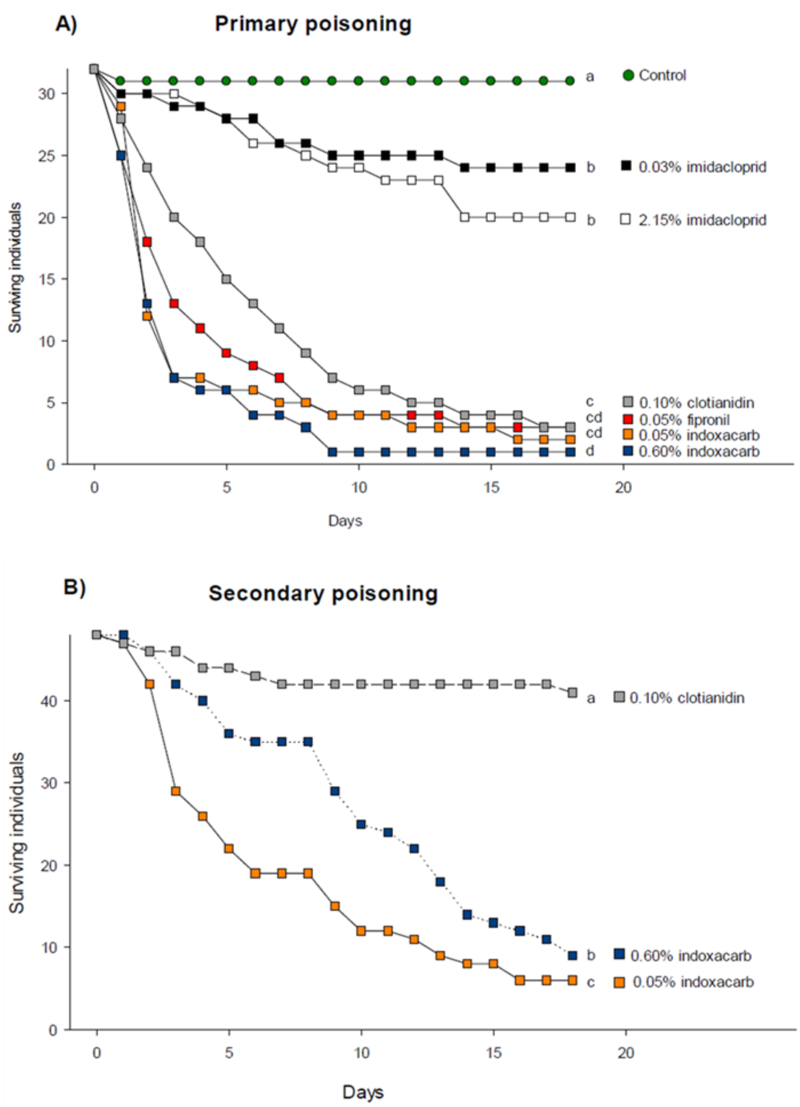

Figure 3. The effect of bait on *Ctenolepisma longicaudatum*. The figures show A) primary poisoning of individuals over days from baits available to Norwegian pest control technicians and B) secondary poisoning of individuals over days when *C. longicaudatum* consumes the individuals having died from the primary poisoning. Different letters indicate significant differences between the active ingredients tested. Figures A and B are collected from (Aak et al. 2020a).

Full-scale field testing. Several locations with a variety of indoor environments ranging from single houses to apartment buildings, commercial premises, and large public buildings were tested for building-wide application of poisonous bait. Pest control technicians from several companies worked together in this full-scale experiment, and their effort was quantified through measurements of both materials and time used during application. Building-wide application was used since all preliminary studies showed strong dispersal abilities of *C. longicaudatum* and detected presence in more than 70% of the building. Technicians were instructed to apply as small droplets as possible, place the droplets along the walls and hidden in cracks and crevices if feasible, and to apply no more than 1 droplet per m^2 of the room. Overall, this yielded a bait use of less than 1g per $100m^2$ and a droplet size of only 0.008-0.009g. With this "wide distribution of small droplets" strategy, the technicians used 10-15 minutes for treatment of apartments with a size of $40\text{-}140m^2$. The control effect was followed by systematic and regular use of sticky monitoring traps, and at all locations, a reduction of 50-90% was achieved within 12 weeks, and complete eradication within 6-12 months (Figure 4 and (Aak et al. 2020b).

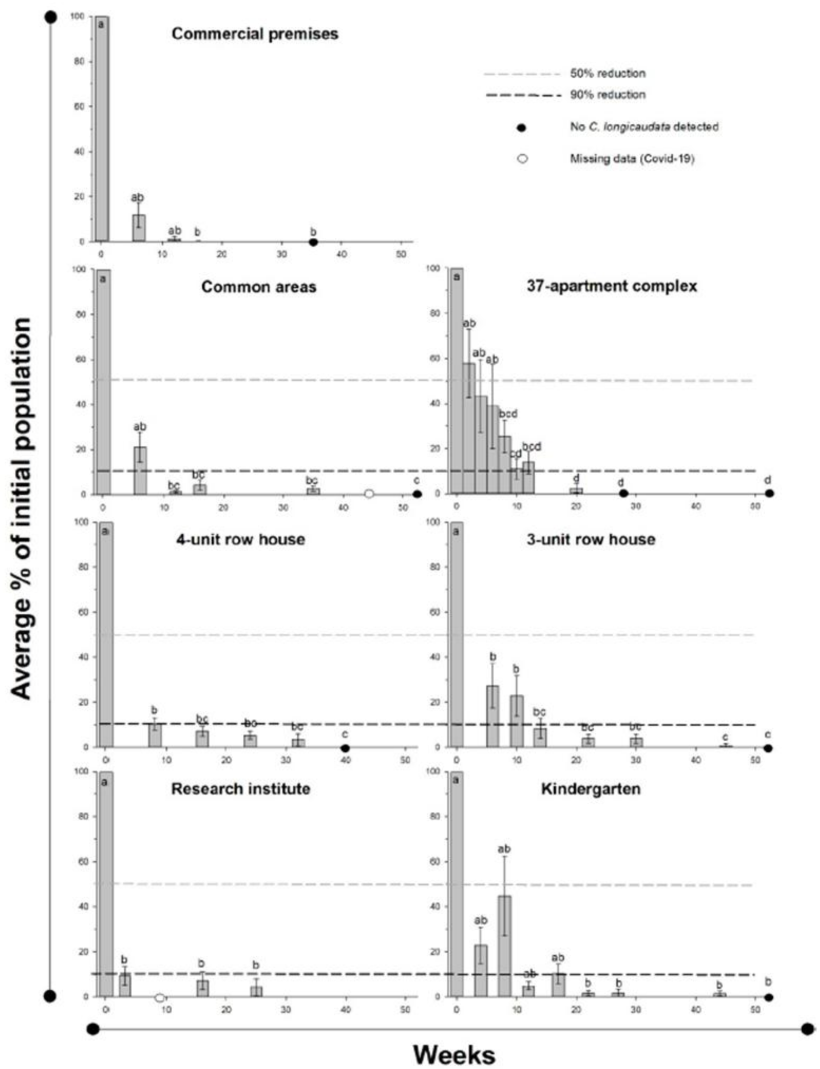

Figure 4. The effect of bait treatment on *Ctenolepisma longicaudatum* populations in various types of Norwegian localities. Different letters indicate significant differences between measurements. Black circles indicate zero-measurements at the different localities. The figures are collected from (Aak et al. 2020b)

Impact on legislation. Positive results from the field investigations in combination with laboratory studies opened the possibility for the Norwegian Environmental Agency to approve bait as a method used for controlling crawling insects, i.e. cockroach control, and thereby also *C. longicaudatum* (approval # NO-2015-0103 (Miljødirektoratet 2019)). The approval was limited to professional PCTs to ensure the correct application of only small bait amounts at hidden locations during treatment, thereby contributing to safeguarding the indoor environment.

Deployment by Norwegian PCCs. The project was established in May 2017, and the method was approved by the Norwegian Environment Agency in February 2019. PCCs and most PCTs started to use the method almost instantly. The project therefore managed to go from no unified control strategy at the initiation of the project to nationwide deployment and full agreement between supplier and purchaser after 20 months of research and development.

Follow up studies. A selection of bait droplets that were collected 6 months after application showed sustained effect (Aak et al. 2020a), and even after as much as 42 months of degradation inside the previously infested buildings, the mortality induced by the old bait was comparable to fresh bait (Aak et al. unpublished material).

DISCUSSION

The *C. longicaudatum* invasion of Norway was interesting because it highlighted many aspects of pest control and the development/use of new strategies. Firstly, it showed a surprising impact from a relatively harmless species. The impact was strong because of a general lack of knowledge related to efficient control. Secondly, it illustrated the power and influence of media in the context of pest issues. Thirdly, it shows the importance of collaboration and knowledge sharing when it comes to development of new methods and strategies, and finally, it highlights the benefits of having a management system that makes demands on multiple stakeholders such as government officials, purchasers, and suppliers of pest control.

Ctenolepisma longicaudatum has a highly cryptic biology, and due to its nocturnal activity, it is very difficult to discover early stages of infestations (Lindsay 1940, Heeg 1967, Aak et al. 2019). They rarely cause notable damage and often escape detection until population densities are high. When this biological aspect is combined with a generation time of several years at room temperature, it is likely that *C. longicaudatum* was established and distributed to many localities of Norway many years prior to what appeared as an explosive invasion (Aak et al. 2021). The media frenzy following the earliest observations of a new pest increased the awareness of this species to promote even more observations and amplified efforts for detection. The dominance of the silverfish issue in fairly new buildings (5-7 years old (Aak et al. 2021)) escalated the media problematization further because it hit the high-end building segment hardest. Early in the invasion, the mass media also showed that many commercial actors in the trade and service industry had severe problems with *C. longicaudatum* in their storage facilities potentially contributing to dispersal. In sum, all these elements added to the feeling of Norway being overrun by the new pest.

The peculiar situation that appeared in Norway was partly beneficial because it created an incentive for a solution among many stakeholders. Residential construction enterprises feared compensation claims, insurance companies feared costly treatments, pest control companies noticed a potential increase in revenues, the trade industry was afraid of a bad reputation, most people feared value degradation of their homes alongside the unpleasantness of having large insects roaming their homes, and the government officials lacked knowledge to provide sound advice. The need for a broad solution therefore forced together many different parties normally situated in competition from a business perspective. This situation opened an arena for collaboration across otherwise closed quarters. The uncertainty of the situation and the following oversized societal response also promoted excessive indoor pesticide application through private use and the standardized PCC-strategies of using sprayable neurotoxic pesticides. Such an undesirable situation underlines the importance of research and scientifically based knowledge, i.e. objectivity in observations, sound evaluation of risk, and robust measurements of effects. Only sober information can build trust and bridge the gaps between the more theoretical institutions, the applied systems, media, and the public. By openly working together and persistently disclosing new results and information, the system was quickly moved towards knowledge-based management of the *C. longicaudatum* issue.

The project was headed by the Norwegian Institute of Public Health and a non-profit insurance company, and we used the Norwegian pest control association (SKABRA) to recruit pest control companies and their technicians. This ensured an aspect of neutrality in the constellation, and it secured a representative selection from the pest control industry. Additionally, we included companies and individuals with known hands-on experience with *C. longicaudatum* control. By doing so, we ensured that the project had representatives that were expected to pay for the services and representatives that would make money on control deliverance. The project structure also ensured qualifications for handling, understanding, and dissemination of information and results from the research in both a scientific manner and towards media. The public and all participants in the project were therefore continuously informed of both plans, execution, and results. In this multifaceted stakeholder setting, we believe that the main key to success was the meetings in the subject group where both suppliers and purchasers were allowed to discuss, describe, and point out concerns and their current knowledge gaps. From a scientific point of view, the issues that all stakeholders highlighted as the major knowledge gaps appeared to be quite simple, but also highly aligned. From a purchaser/supplier point of view, they typically had the form of *we cannot pay for services unless we know what works* (purchaser) and *we cannot deliver services unless we know what works* (supplier). Similarly, when bait was identified as a solution, the purchasers and suppliers said *we want to purchase services with the most efficient bait,* and *we want to supply services with the most efficient bait*, respectively. Finally, towards the end of the project, both suppliers and purchasers needed to know how much time is required before eradication is achieved and if silverfish absence could be expected at a treated locality in the long run. A similar alignment of interest was also observed between all participating PCCs and most of their PCTs. They all desired and expected almost the same from the project and requested answers to very comparable issues. The inclusion of PCTs in the subject group and their cross-company collaboration in field experiments tied the project structure even tighter together. The collaboration and discussions were therefore surprisingly fruitful and open, and the PCCs responded very positively to a situation closely resembling a theoretical coopetition framework (Bouncken et al. 2015, Corbo et al. 2023). The strength of this knowledge building flow was likely achieved because the government officials acted as a mediator and a tool for achieving improved business for all stakeholders. The management system of Norway is also organized in an open and transparent structure with many common meeting grounds, where PCCs, PCTs, commercial players, and government officials meet and exchange experiences. This is beneficial for collaboration because it creates a high level of trust between the different parties.

Even though the scientific questions were rather basic, the means to answer them were rather complex. Most of the knowledge we needed to obtain required field studies in infested buildings to ensure and document the true effects. Within the framework of the project, the availability of both study sites and highly professional pest control technicians was good because large scale players in the market collaborated. This provided access to highly suitable study sites and high-quality field work through dedicated PCTs, and we were allowed to design relevant studies with the necessary scientific strength to draw conclusions. Even more important in this context was probably the ownership of all involved parties to the scientific findings. Our experience within this setting was that both the pest control technicians and their customers wanted to utilize the new strategy long before the scientific conclusions could be drawn, and the formal approval was given by the Norwegian Environment Agency. The positive effect from ownership to the scientific findings is particularly evident when considering the extremely low dose of bait required for eradication. Without strong participation in the research by the PCCs, we believe it would have been difficult to convince PCTs to apply as little as 1g of bait per $100m^2$. The between pest control company competition in the market outside of the project also ensured that the subject managers instantly disseminated new findings within the companies to ensure their competitive ability in a quickly changing market, and several PCCs use the argument of safety in the treatment with low doses. The management system in Norway which include education, also contributed to rapid dissemination of new and correct information.

CONCLUSIONS

From a research perspective, it was surprising to observe how well the collaboration between the different parties (supplier and purchaser) and several different pest control companies worked out. At least in Norway, the opinion often is that companies don't share knowledge because of competition, but we observed the opposite situation. The pest control companies shared knowledge willingly because of competition and their subsequent potential to become better in their line of work. This might be assigned to the initially limited knowledge regarding control of this "new" pest species, but currently we are running a project with the same constellation on the old and familiar bed bug problem, and we see much of the same effects. In general, it appears that the purchasers of services and all the pest control companies are highly aligned in both their desires for knowledge and their requests for improvements in methodology. The observations from the Norwegian management system indicate that cooperation in a competitive framework is beneficial both for the innovation process and for rapid application of new control strategies.

REFERENCES CITED

Banks, N. C., D. R. Paini, K. L. Bayliss, and M. Hodda. 2015. The role of global trade and transport network topology in the human-mediated dispersal of alien species. Ecology Letters 18: 188-199.

Bonnefoy, X., H. Kampen, and K. Sweeney. 2008. Public health significance of urban pests, World Health Organisation, Copenhagen, Denmark.

Bouncken, R., J. Gast, S. Kraus, and M. Bogers. 2015. Coopetition: a systematic review, synthesis, and future research directions. Review of Managerial Science 9: 577-601.

Buczkowski, G. 2014. Urban pest management: the need for a correct mixture of knowledge and practice. CABI: 195–204.

Corbo, L., S. Kraus, B. Vlacic, M. Dabic, A. Caputo, and M. M. Pellegrini. 2023. Coopetition and innovation: A review and research agenda. Technovation 122.

Dawson, W., D. Moser, M. van Kleunen, H. Kreft, J. Pergl, P. Pysek, P. Weigelt, M. Winter, B. Lenzner, T. M. Blackburn, E. E. Dyer, P. Cassey, S. L. Scrivens, E. P. Economo, B. Guenard, C. Capinha, H. Seebens, P. Garcia-Diaz, W. Nentwig, E. Garcia-Berthou, C. Casal, N. E. Mandrak, P. Fuller, C. Meyer, and F. Essl. 2017. Global hotspots and correlates of alien species richness across taxonomic groups. Nat. Ecol. Evol. 1: 1-7.

Dhang, P. 2011. Urban pest managment - an environmental perspective, CABI, Cambridge,

Dhang, P. 2014. Urban insect pests - sustainable managment strategies, CABI, Cambridge

Dhang, P. 2016. Innovations in insect baiting and its role in reducing insecticide load in urban pest control. Int. Pest. Control. 58: 210-212.

Heeg, J. 1967. Studies on Thysanura. II. Orientation reactions of *Machiloides delany* Wygodzinsky and *Ctenolepisma longicaudata* Escherich to temperature, light and atmospheric humidity. Zoologica Africana 3: 15.

Hulme, P. E., S. Bacher, M. Kenis, S. Klotz, I. Kuhn, D. Minchin, W. Nentwig, S. Olenin, V. Panov, J. Pergl, P. Pysek, A. Roques, D. Sol, W. Solarz, and M. Vila. 2008. Grasping at the routes of biological invasions: a framework for integrating pathways into policy. J. Appl. Ecol. 45: 403-414.

Kim, K. H., E. Kabir, and S. A. Jahan. 2017. Exposure to pesticides and the associated human health effects. Sci. Total Environ 575: 525-535.

Lindsay, E. 1940. The biology of the silverfish, *Ctenolepisma longicaudata*, with particular reference to its feeding habits. Proc. of the Royal Society of Victoria 52: 35-83.

Mallis, A. 1941. Preliminary experiments on the silverfish *Ctenolepisma urbani* Slabaugh. J. Econ. Entomol. 34: 787-791.

Mattsson, J. 2014. En ny børstehale (Lepismatidae) påvist i Norge. Insekt-Nytt 39: 61-64.

Miljødirektoratet. 2019. Skjeggkre-middel tillates. Norwegian Environment Agency: Gov. agency under Ministry of Climate and Env. https://www.miljodirektoratet.no/aktue1t/nyheter /2019/februar-2019/skjeggkre-middel-tillates/.

Ministry of Health and Care Services. 2000. Norwegian pest control regulation. Norwegian law - Ministry of Health and Care Services I-1012 B: 1-16.

Padayachee, A. L., U. M. Irlich, K. T. Faulkner, M. Gaertner, S. Proches, J. R. U. Wilson, and M. Rouget. 2017. How do invasive species travel to and through urban environments? Biol. Invasions 19: 3557-3570.

Pergl, J., P. Pysek, S. Bacher, F. Essl, P. Genovesi, C. A. Harrower, P. E. Hulme, J. M. Jeschke, M. Kenis, I. Kuhn, I. Perglova, W. Rabitsch, A. Roques, D. B. Roy, H. E.

Roy, M. Vila, M. Winter, and W. Nentwig. 2017. Troubling travellers: are ecologically harmful alien species associated with particular introduction pathways? NeoBiota: 1-20.

Radcliffe, E. B., R. E. Cancelado, and W. D. Hutchison. 2008. Integrated pest management: concepts, tactics, strategies and case studies, Cambridge University Press, Cambridge.

Rani, L., K. Thapa, N. Kanojia, N. Sharma, S. Singh, A. S. Grewal, A. L. Srivastav, and J. Kaushal. 2021. An extensive review on the consequences of chemical pesticides on human health and environment. J. Clean. Prod. 283: 124657.

Robinson, W. H. 2005. Urban insects and arachnids - a handbook of urban entomology, Cambridge University Press, Cambridge, USA.

Rukke, B. A., M. Hage, and A. Aak. 2021. Spatiotemporal elements in a poisoned bait strategy against the long-tailed silverfish (Lepismatidae: Zygentoma). PLoS One 16: e0260536.

Sakhi, A. K., E. Cequier, R. Becher, A. K. Bolling, A. R. Borgen, M. Schlabach, N. Schmidbauer, G. Becher, P. Schwarze, and C. Thomsena. 2019. Concentrations of schemicals in indoor air from Norwegian homes and schools. Sci. Total Environ 674: 1-8.

Wang, C., A. Eiden, R. Cooper, C. Zha, D. Wang, and E. Reilly. 2019. Changes in indoor insecticide residue levels after adopting an integrated pest management program to control German cockroach infestations in an apartment building. Insects 10: 1-12.

Wigle, D. T., T. E. Arbuckle, M. Walker, M. G. Wade, S. L. Liu, and D. Krewski. 2007. Environmental hazards: Evidence for effects on child health. Journal of Toxicology and Environmental Health-Part B-Critical Reviews 10: 3-39.

Womersley, H. 1937. Studies in Aust. Thysanura - Lepismatidae. Trans. Roy. Soc. Aust.: 96.

Zhu, F., L. Lavine, S. O'Neal, M. Lavine, C. Foss, and D. Walsh. 2016. Insecticide resistance and management strategies in urban ecosystems. Insects 7: doi:10.3390/insects7010002.

Aak, A., M. Hage, and B. A. Rukke. 2020a. Long-tailed silverfish (*Ctenolepisma longicaudata*) control; bait choice based on primary and secondary poisoning. Insects 11: 1-10.

Aak, A., B. A. Rukke, P. S. Ottesen, and M. Hage. 2019. Long-tailed silverfish (*Ctenolepisma longicaudata*) – biology and control (revised edition - 2019), pp. 43. Norwegian Institute of Public Health - Oslo, Norway - www.fhi.no, Dept. of Pest Control.

Aak, A., M. Hage, H. H. Lindstedt, and B. A. Rukke. 2020b. Development of a poisoned bait strategy against the silverfish *Ctenolepisma longicaudata*. Insects 11: 1-16.

Aak, A., M. Hage, R. Byrkjeland, Ø. Magerøy, H. H. Lindstedt, P. S. Ottesen, and B. A. Rukke. 2021. Introduction, dispersal, establishment and societal impact of the long-tailed silverfish *Ctenolepisma longicaudata* in Norway. BioInvasions Rec. 10: 483-498.