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Maintenance of the crab louse, *Pthirus pubis,* in the laboratory and behavioural studies using volunteers

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Summary

Infections with crab lice (*Pthirus pubis*) remain common and may be increasing. These are difficult insects to maintain in captivity and in consequence their behaviour has been poorly studied. We were able to breed them in semi-natural conditions and obtained enough to be able to study their behaviour during the twenty-four hours following being released onto a volunteer. The results indicated that they are a more mobile insect than was previously thought and this finding has influenced our beliefs concerning their transference between hosts.

INTRODUCTION

Human infection with lice is still widespread today. The advent of organochlorine insecticides initially reduced their prevalence but the development of resistance by some strains has caused a resurgence of infection; particularly of the head louse, *Pediculus humanus capitis.*[2,3,5,6,10] Little information is available regarding levels or distribution of infection with the crab louse, *Pthirus pubis.* Hearsay evidence suggests that this species is much more common and widespread than official figures would suggest but most sufferers are so appalled by the apparent connotations of the infection that they resort to a variety of means of self-treatment rather than seek professional help. Many of these home cures are not only potentially hazardous but also ineffective or inefficient and do not eradicate the offending insects. What little information is available suggests that infection with crab lice is increasing in prevalence.[1,4] If infected people continue to exercise inefficient treatment of crab louse infections then insecticide resistance is sure to develop. If such is the case a greater knowledge of its normal habit will be necessary.

Since all species of anopluran lice require regular and frequent blood meals from their specific host, maintenance of these insects in the laboratory presents some problems. In the case of *P. humanus* and *Pth. pubis* numbers of human volunteers are required to maintain captive insects on themselves.

Nuttall[7] kept body lice, *P. humanus humanus,* in gauze-bottomed pill boxes strapped to the skin of the arm. He also kept *Pth. pubis* in a length of stocking taped around a leg.[8] The boxes used for body lice are not suitable for crab lice since they do not allow free enough access to the host's skin. The stocking method for crab lice was considered unsafe, in that it could easily

become detached with obvious consequences, and offered no protection, for the lice or the host, from unconscious scratching following irritation caused by the louse bites. It was decided to use a modified version of the method used by Maunder for head lice.[5]

MATERIALS AND METHODS

Lice were obtained from patients attending hospital clinics and respondents to advertisement around the University and to magazine articles.

Captive lice were kept in bottomless aluminium boxes with flanged bases and screw caps, perforated to allow air to enter The forearms of the volunteers were shaved prior to attachment of the culture boxes. The flange of each box was glued to a 6 cm wide strip of adhesive bandage and a hole matching the interior of the box cut in the bandage. A bunch of pubic hair was placed onto the skin to give the lice something suitable to grasp and on which to lay their eggs. A spring of folded paper was used to hold the hairs close to the skin.

With experience we found that inclusion of pubic hair in the culture boxes was unnecessary, provided that the volunteer had adequate quantity and robustness of natural arm hair. The arm, in this case, was shaved and the hair allowed to grow for about a week prior to use. This allowed the lice sufficient length of hair for anchorage and egg laying without making it difficult to remove them when required.

The boxes were moved every four or five days to a new site. Initially skin irritation was minimal but after about 21 days of continuous arm maintenance, of the colony of lice, the irritation resulting from the biting became intense at each new site. The actual biting site became papular, vesicular and even haemorrhagic. Such pathological effects seemed to have no effect on the feeding or behaviour of the lice. Nymphal stages tend to remain in one position with their mouth parts embedded in the skin and it was not uncommon to find that serous vesicles had developed at the biting site and almost engulfed the head of the louse without affecting its feeding.

The development of the bluish spots called *maculae cerulae,* that were considered a specific diagnostic aid in the past, were only observed transiently on two of the volunteers and never on patients.

Some of the volunteers had previously been used to feed head lice and these individuals developed delayed hypersensitivity and later immediate hypersensitivity reactions more rapidly than others who had never before been bitten by lice. The development of the specific immune response did not seem to affect the survival of the lice. Volunteers who had previously been sensitised to mosquitoes or to bed bugs, *Cimex spp,* showed no reaction to bites from lice whereas a volunteer sensitised to lice developed a papular reaction within thirty minutes. This observation indicated that there is a specific, cross-reacting immunity developed to saliva from anopluran lice that is distinct from that developed to the saliva of other insects.

Lice that had been contained in culture boxes on a single host for some time often remained static during the host's active period and commenced movement, themselves, after the host had settled down for rest at night. Such an observation is consistent with what we already know about head lice, *P. humanus capitis,* and clothing lice, *P. humanus humanus,* in that they react to changes in the host's body temperature and the relative humidity of the environment of the skin surface and clothing layer.[6] While the human host is active the crab louse remains firmly attached to the hairs of the host's body, flattened against the skin. In this position it stands the least risk of being rubbed off by abrasion of the clothing against the skin or by scratching. However, once the host is resting, apart from unconscious scratching, the risks to the active louse are very few. Thus the insects can set about disseminating themselves around the host's body and seeking mates or even new hosts.

Some lice, particularly females, were found to wander around in the culture boxes for long periods. Such movement was particularly common in insects transferred from one host to

another. Since the female crab louse has a spermatheca, unlike the other human lice, and in consequence probably only requires to be fertilised once during its active egg laying life.[6,11] The most likely means of dissemination of the species is by inseminated females actively seeking a new host or area of the same host on which to lay their eggs. Unlike other human lice the crab louse is not communal in its habit, the individuals being generally spread out over the host's body as far as coarse hair distribution permits. Consequently males and unmated females would find an absolute necessity to wander around in search of a member of the opposite sex. Since the areas of the body concerned are relatively enormous mate-finding poses apparent difficulties, indicating that sperm storage may be an absolute requirement rather than a convenience for this species.

Unlike the head louse the crab louse's opportunities for finding a new host are relatively restricted, partly by the relative slowness of its movement, resulting from its peculiar anatomy, and partly because so little of its habitat, the hairy parts of the human body, is exposed to the possibility of contact with a new host for much of the time. With such restrictions it would appear that the crab louse needs to be as opportunistic as possible in host seeking, but nevertheless we obtained some evidence that the lice can exercise preferences.

However carefully lice are transferred from one person to another, in the laboratory, occasionally one or two of the insects are damaged and survive for only a short time after transfer. On some occasions, however, whole populations of lice removed from a patient to a volunteer died after a very short period. These lice were of all ages, being a mixture of nymphs and adults, and on subsequent examination had suffered no apparent damage. They had all failed to feed from the new host and in most instances had made no attempt to do so. Whether these lice were unable to feed or unwilling to do so is a matter of speculation but since the insects concerned had suffered no observable damage the latter would seem the more likely possibility. Since crab lice probe around on the skin with their head papillae and setae before biting it is possible that the may be put off by some of the chemical constituents of a potential host's sebaceous products.

Since mosquitoes have been demonstrated to show a predilection toward certain blood groups when biting the same may be true in the case of the crab louse.[9] It is more likely that the lice themselves have preferential states or times for transfer and that forced transplants are inherently unlikely to succeed. In most insects a distinct dispersal phase, sometimes amounting to frank migration, follows mating, and something of this is seen in other lice. If crab lice show a preference toward some potential hosts rather than others it means that the transmission of lice from one person to another is not a random occurrence precipitated by proximity alone: it is rather a positive migration of suitably maturated, fertile and active lice under favourable circumstances. If such is the case, differences of behaviour would be expected between lice prepared in their physiology for transfer to a new host and those forcibly transported by laboratory workers.

In order to observe effects of this type, lice from different sources were removed from their hosts and each group dusted with zinc and calcium phosphide powders. These powders are in themselves harmless to the lice but on exposure to ultra violet light they fluoresce. A variety of different colours are available.

One of the reasons that the crab louse has a reputation for a totally sedentary nature is that it is almost always observed in the clinic or laboratory using strong illumination when it grasps tightly onto its anchorage points and flattens itself against the skin of the host. It is an obvious defence reaction of any creature that lives virtually its entire life in the dark to attempt to make itself as inconspicuous and secure as possible the moment a strong light is shone upon it. Furthermore, the only times that the louse is exposed to light under normal circumstances is when the host is undressing, the selection pressures for lice to make themselves inconspicuous at such times are understandably high. Since laboratory sources of ultra violet light are relatively dim and this wavelength is also unlikely to stimulate much beyond the threshold of

the louse visual capacity, it was expected that the normal behaviour of the lice so observed would be unaffected.

Lice dusted with phosphide powders were mixed and deposited onto the pubic hair of a male volunteer who had a contemporaneous natural infection. Three distinct populations of lice were used: a) a population of mixed genetic background from an established culture box; b) from a female patient; c) lice removed from the volunteer's own infection. Each of these groups was allocated a distinctive coloured powder.

On deposition the lice from the volunteer's own population were very active and moved around rapidly by swinging from hair to hair. They quickly distributed themselves across the subject's abdomen. Lice from other sources moved slowly and attached themselves to hairs close to the skin. They remained static for long periods and appeared reluctant to feed even after more than two hours.

During the following 24 hours the activity of the three groups altered somewhat. Although it was not possible to observe their behaviour continuously the changes of distribution of the members of each population were an effective indication of the activity of the lice. The lice from each population were immediately recognisable on illumination with ultra violet since the coloured powders adhered to the lice's cuticles. The lice from the natural infection settled down and were all found around the pubic and peri-anal regions. The introduced lice migrated over considerable distances. Those from the culture box population congregated on the subjects thorax whereas those from the female patient migrated furthest, to his axillae, thighs and lower legs.

The extent and rapidity of this dissemination of the lice over the subject's body is in contrast to the observations of Nuttall who was surprised to note that one louse of his colony had moved 10 cm during one day.[8] This single observation has largely influenced thought since, and together with their reaction to bright light has given the crab lice the reputation of being sedentary animals. However, these observations suggest the converse is true and that these insects are extremely active under the right circumstances. Consequently transfer of lice from one person to another in close proximity could be easily effected whilst they are in a quiescent state, and the lice are apparently able to detect this.

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