Report on survey for Oak Processionary Moth *Thaumetopoea processionea* (Linnaeus) (Lepidoptera: Thaumetopoeidae) (OPM) in London in 2007

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1. EXECUTIVE SUMMARY

Oak Processionary Moth (OPM) is a well-known pest in continental Europe. It is a forest pest, sometimes occurring in vast numbers causing extensive, potentially damaging defoliation of deciduous species of oak. The distribution is mainly central and southern, but since the 1980s it has spread northwards in Belgium, Holland, Germany and France, with migrant males in Britain and Denmark. Minute hairs on the back of the larvae cause unpleasant skin irritation and other allergic reactions, occasionally severe, in people and animals. The increased distribution has resulted in many reports of health problems in continental Europe, in some cases necessitating hospital treatment.

In 2006, infestations of OPM larval nests were found in the London Boroughs of Richmond and in Ealing on the border with Brent. Evidence strongly suggests that these were the result of accidental importation of eggs of the moth on planted semi-mature trees, in both cases a form of Pedunculate Oak known as Cypress Oak (*Quercus robur* f. *fastigiata*). These trees were at the main infestation sites, and were imported from continental Europe 2-4 years previously. Large populations had developed at both sites prior to their discovery, with dispersal having occurred into the local area to a distance of at least 1km (in Richmond). OPM easily colonises urban areas, as it prefers warm, sunny sheltered sites for breeding.

Eradication in 2006 did not succeed. It was concluded that further infestations were very likely to occur in 2007. This was confirmed by initial surveys in early May, after which the Forestry Commission's Plant Health Service initiated its Plant Health Contingency Plan and formed an Outbreak Management Team. The main aims of the 2007 work were to assess by survey the status of the London colonies, estimating geographical extent and abundance in order to guide future control measures, and to facilitate the destruction of as many nests as possible before emergence of the moths. The adult population was also to be monitored through a programme of pheromone traps sited in all London Boroughs.

Working in collaboration with staff from borough councils and landowners, visual inspections of oaks were made from the ground over a wide area covering Ealing, Brent, Richmond, Hounslow and Chiswick. An estimated 708 nests were found, 534 in the Ealing/Brent infestation (458 in Ealing, 76 in Brent) and 174 in Richmond/Hounslow (171 in Richmond, 3 in Hounslow).

Nests were mainly concentrated in relatively small areas with few outliers (the furthest at roughly 1km in Ealing), although the spread was greater in Richmond (to roughly 2.5km). The origin in Ealing/Brent was roadside plantings, but the moth had spread to nearby railway embankments on native Pedunculate Oaks, and here the largest concentrations were found. Other nests were found on nearby street trees and amenity plantings, and in private gardens. In Richmond, a large colony was present on a privately run housing estate, and had spread to Royal Botanic Gardens Kew (RBGK) where nests were numerous in the extensive oak collection, and to an adjacent golf course and public park.

Inspection from the ground was effective in terms of detecting the presence of a colony, but tree climbers often found further nests not visible from ground level once presence was established. With the cooperation of borough council staff, good coverage (in terms of ground surveys) of street trees and other public areas was achieved in both areas. However, given the geographical spread and abundance of suitable host trees in both areas, it is likely that a small number of single, isolated nests away from the main concentrations (i.e. where tree climbers were not used) were missed. It is nevertheless concluded that the method was adequate in terms of assessing the overall distribution of the colonies. In Ealing, all residents were sent information leaflets and asked to report any sightings of OPM. This was also an effective method and led to significant discoveries.

Notices were served on landowners to remove the nests under Article 31(4) of the Plant Health (Forestry) Order 2005. Advice was given, and feedback collected after nest removal. Methods employed for removal and disposal varied, but the information gathered should enable formal guidance to be developed on control measures, included PPE. No health problems were encountered by operatives, other than minor skin rashes. Site managers were generally cooperative, although response times varied considerably. In spite of this, it is concluded that a very high percentage of the nests at the main sites were destroyed before emergence of moths could take place. Service of Notice was useful, and was welcomed by some site managers as it helped them justify release of resources.

Delta-type pheromone traps deployed over a wide area caught no moths, but bucket-type traps with a different origin caught 31 moths in RBGK. The reason for the result with the Delta traps is as yet unclear, although technical failure is a possibility. Single adult males were found in Richmond and Barnes. Cool, exceptionally wet weather in the summer of 2007 may have helped to reduce the OPM population, along with parasitoid wasps, to which several larvae were found to be host. This

is relatively unusual in a species colonising new ground. Since the populations have been significantly reduced, an attempt at eradication could be successful and should therefore be given serious consideration, with surveys and leafleting campaigns throughout the affected boroughs.

Tightening of phytosanitary controls at the point of consignment would reduce the likelihood of further accidental introductions, and measures are underway aimed at achieving this. The apparent ease with which OPM became established in London illustrates the potential for larger-scale problems.

2. INTRODUCTION

2.1 Background

This report details the findings of surveys for larval nests and adults of Oak Processionary Moth in London in 2007, following the discovery of two populations in 2006, both centred around amenity plantings of Cypress Oaks (*Quercus robur* f. *fastigiata*) imported into Britain as semi-mature trees. This moth is a major oak defoliator in other parts of Europe and its urticating larvae pose a health risk to both humans and animals. It has shown a marked northerly range expansion since the 1980s and problems have at times been severe, especially in areas recently colonised, necessitating the use of significant public resources. The London discovery is therefore a cause for concern.

OPM was found on a privately-run residential estate close to the River Thames in Richmond on trees planted to screen a Thames Water plant in July 2006. Nearby residents and workers at the plant reported suffering rashes as a result of what they described as “insect bites” and it was suspected that the agent responsible had emanated from the plant. Subsequent identification of an estimated 10,000 larvae and considerable tree damage, led Richmond Borough Coucil to commission a survey of the wider local area, and nests were found in North Sheen cemetery and RBGK (Townsend, 2007).

Another population was discovered independently in 2006 in Ealing and adjacent parts of Brent, on roadside tree plantings, by landscaping contractors. This was reported to Defra and posted on their pest interception web pages. As a result of searches of these pages, further investigation and site visits in 2006, several nests were found. These are the first known instances of this moth breeding in the wild in mainland Great Britain, although it was already present as a resident breeding species in the Channel Islands, from where it was first recorded in 1983 (Waring *et al*, 2003).

Attempts at eradication were made in both areas, but it was accepted that not all nests were likely to have been found and destroyed, and it was concluded that further infestations where very likely to occur in 2007. The origin was almost certainly semi-mature trees introduced into Great Britain from the continent within the previous 2-3 years, overwintering eggs having been transported unnoticed. OPM has been recorded in small numbers in mainland Britain as a natural immigrant (males only), but the recent pattern of immigration makes a natural colonisation origin seem most unlikely. While the male moth is a reasonably strong flier, the female is unlikely to be able to make it across the English Channel unaided. Discussion with growers revealed that in recent years Cypress Oaks have been regularly imported from parts of Europe where the moth occurs, and a label on a Richmond tree confirmed that the trees originated in an area where the moth occurs, in southern Holland.

Discussions took place in winter 2006-07 between Forest Research, RBGK, Defra, the Health Protection Agency, and Richmond and Ealing Borough Councils. A Tree Health Forum was held at RBGK in May 2007, focussing on OPM and other insect tree pests. As a result of these initiatives, and the results of surveys carried out in May immediately before the Tree Forum, the Forestry Commission's Plant Health Service initiated its Plant Health Contingency Plan and formed an Outbreak Management Team. Further surveys were commissioned by both Borough Councils and the Forestry Commission under a coordinated programme of action. This report presents the results of those surveys and summarises the life history, European distribution and deleterious effects of OPM.

2.2 Survey Remit

- Survey for the communal nests of the larvae at known sites and in the wider local area, liaising with local Borough Councils and other landowners.
- Assist with surveys for adults, placing pheromone traps in outbreak areas.
- Work with landowners, pest control, landscaping and maintenance contractors to locate and remove nests, overseeing removal and destruction, providing advice on methods and safety including PPE.
- Serve Notices under Article 31(4) of the Plant Health (Forestry) Order 2005.
- Provide advice and disseminate information to interested parties.

- Liaise with the OPM Outbreak Management Team on progress and report findings.

2.3 Aims

- Estimate geographical extent and overall numbers of nests, and assess the status of the moth in outbreak areas, in order to help the OMT plan future control and eradication measures.

- Facilitate removal of nests, ensuring that all reasonable efforts are made to survey and remove nests without endangering the health of pest control operatives and the public.
- Assist in co-ordinating the response to the arrival of OPM in Great Britain.

2.4 Summarised information on Oak Processionary Moth

2.4.1 Life history

The larvae of Oak Processionary Moth feed on the leaves of a variety of deciduous oak *Quercus* species, including the native British species Pedunculate Oak *Q. robur* and Sessile Oak *Q. petraea*. Eggs are laid in batches on a twig. Trees in open, sunny habitats are favoured, often at the edge of woodland or isolated trees in open places, frequently in urban situations and including small trees. The larvae hatch in late April or early May and stay at first in groups among the leaves (figure 1). In the 3rd instar they move to a trunk, bough or main stem where a communal silken nest is constructed, from which they move en masse in 'processions' back to the foliage to feed (figure 2).

The nests are often conspicuous, and persist on trees for up to a year following infestation. They retain large numbers of the toxic hairs, and as an added protective adaptation, the unusually robust larval exuviae (caste skins) remain adhering to the nest. The height of the nest from the ground varies considerably. On large trees it is often 20m or more from the ground, but may low as 1-2m, and (usually on smaller specimens) may actually be touching the ground. It is very often in a sheltered position, under a branch. The aspect is often southerly, or oriented towards the warmer, less shaded side of the tree. The nest is rounded and sometimes somewhat elongated, and strongly attached to the tree by thick threads of silk extending outwards. Strands of silk can also sometimes be seen extending along limbs towards the feeding areas.

Feeding is characterised by stripping of each leaf to the mid-vein, which usually remains more or less intact. Since the larvae feed in groups, patches of stripped leaves are often seen, but these often

only become apparent when the larvae are well grown. When they are still active, the nest is whitish, turning brown with age. When seen in silhouette it may appear as a bulge. Pupation occurs within the nest in late June or July, the adults emerging from late July to mid September.

The moths have forewing length 14-17mm, and are rather thickset. The antennae are feathered, strongly in the male. Forewing pale brownish-grey, with a small, faint dark central crescent mark, smooth, rather wavy blackish cross-lines, and pale basal area. They are nocturnal and both sexes are attracted to artificial light, sometimes occurring in light traps in very large numbers. The male disperses widely, and is regarded as migratory although the female appears to disperse much less widely. Neither sex feeds in the adult stage and are short-lived, living roughly 3-4 days.

2.4.2 European distribution

There are three common and widespread species of processionary moth (family Thaumetopoeidae) in Europe, namely Oak Processionary *Thaumetopoea processionea*, Pine Processionary *T. pityocampa* (Denis & Schiffermüller) and *T. pinivora* (Treitschke). Historically, the distribution of Oak Processionary has been southern and central, but since the 1980s it has been expanding northwards and has colonised areas of Holland, Germany, Belgium and France in which it was previously rare or absent. This expansion is considered to be most likely a result of climate warming. There is one reliable record of *T. pityocampa* in Great Britain, a single male at a light trap in Buckinghamshire in July 1966 (Waring *et al*, 2003). It is not known whether this was a natural immigrant or an introduction and its status can be described as "absent: intercepted only". *T. pinivora* has never been recorded in Great Britain.

T. processionea was first recorded in Holland in 1991, and rapidly became a major pest, in Denmark for the first time in 1996 when 26 were caught, all males (Skule and Vilhelmsen, 1997) and recently in southern Sweden. It was first seen in the Channel Islands in 1983, where it is now resident in Jersey (Waring *et al*, 2003) and was first recorded as a natural immigrant in mainland Britain in 1983 (1 in Cornwall), with 28 to 2006 almost exclusively from the south or southeast coast of England, always as adult males in light traps, and none from the London area. The highest number (12) occurred in 1995, when its abundance in Holland was rapidly increasing, as measured by incidences of tree damage (Moraal *et al*, 2002). This declined rapidly from 1997. This was thought to be due to a combination of control measures and colder weather. Arrivals of adults in Great Britain also showed a parallel decline (1996 = 1, 1997 = 0, 1998 = 2, 1999 to 2003 = 0).

There were 7 in 2004, 0 in 2005 and 2 in 2006 (other than those resulting from the London outbreaks).

2.4.3 Defoliation of trees

The spectacular numbers of OPM larvae that can occur in extensive oak woodland during severe outbreaks cause defoliation of entire trees, sometimes over a wide area. Large trees are normally able to recover from defoliation by lepidopteran larvae, but if this is repeated over several years the tree may suffer and the effects of the larvae can be a factor in weakening the tree defences against attack by other organism such as fungi and environmental stresses such as drought. In these circumstances the death of the tree may result. Where this happens on a large scale, there may be detrimental ecological and economic impacts. The potential for this sequence of events to happen in Britain is arguably greater than elsewhere, due to the lack of natural control (see below) although climate may impose restrictions on its ability to spread. Defoliation is illustrated in figure 3, with a tree infested the previous year showing a high degree of stress.

2.4.4 Deleterious effects on human and animal health

Processionary moths have evolved a potent defence strategy against predators. The adults are harmless, but from the 3rd instar the larvae in addition to being clothed in long, silvery hairs also possess an estimated 60,000 very short hairs 0.1-0.2 mm in length. These arise from red spots on the back, containing toxic proteins known as thaumetopoeins, which cause the release of histamines in humans (i.e. an allergic reaction). In some people and animals the reactions are severe and including dermatitis, conjunctivitis and pulmonary affection (known collectively as lepidopterism). There are a small number of recorded cases of anaphylactic shock in humans in cases of high exposure to OPM.

Extreme reactions only occur in a small percentage of the human population, but sensitivity can increase quite rapidly with exposure events. People who on first contact are either unaffected or only slightly so, may develop more severe symptoms after only a small number of encounters with the larval hairs. Populations of OPM larvae can build up to extremely high numbers and in some recently-colonised areas of Europe large numbers of people have been affected, as have domestic animals, in which the symptoms are very similar. The propensity of the female to lay egg batches on isolated trees (see figure 4) and those at the edge of woodland i.e. in sunny situations, increases the risk of exposure. Recorded instances of large numbers of people being affected include an

incident at a recreation area in Germany (Gottschling and Meyer, 2006) and along roadsides where maintenance work was being carried out, also in Germany (B. Ismay, pers. comm.). In 2006, the BBC reported that hundreds of people had reported symptoms in a single town in Belgium, and horses had to be confined to stables. The hairs are easily dislodged and drift on local air currents, so that symptoms often occur in individuals who have had no direct contact with larvae and were several metres from infested trees.

2.4.5 Control by natural predators

The possibilities for natural biocontrol of OPM are somewhat limited. The toxicity of the larvae means these have relatively few specialised natural predators, and that OPM is likely to be generally avoided by birds and mammals. Moreover, since OPM is not an endemic species in Britain, any specialised predators will be absent. However, parasitoid wasps were found to be present in samples collected in London. The species involved, *Pimpla rufipes* (Miller), is a generalist predator of lepidopteran larvae (Mark Shaw, pers. comm.), and the closely related *P. processioneae* (Ratzeburg) is a specialist parasitoid of OPM and other processionary larvae.

Figure 1. Early instar larvae with feeding damage. St. James Estate, Richmond 3rd May 2007 (photo M. Townsend).

Figure 2. Larvae massing on trunk and in procession on. St. James Estate, Richmond 3rd May 2007 (photo M. Townsend).

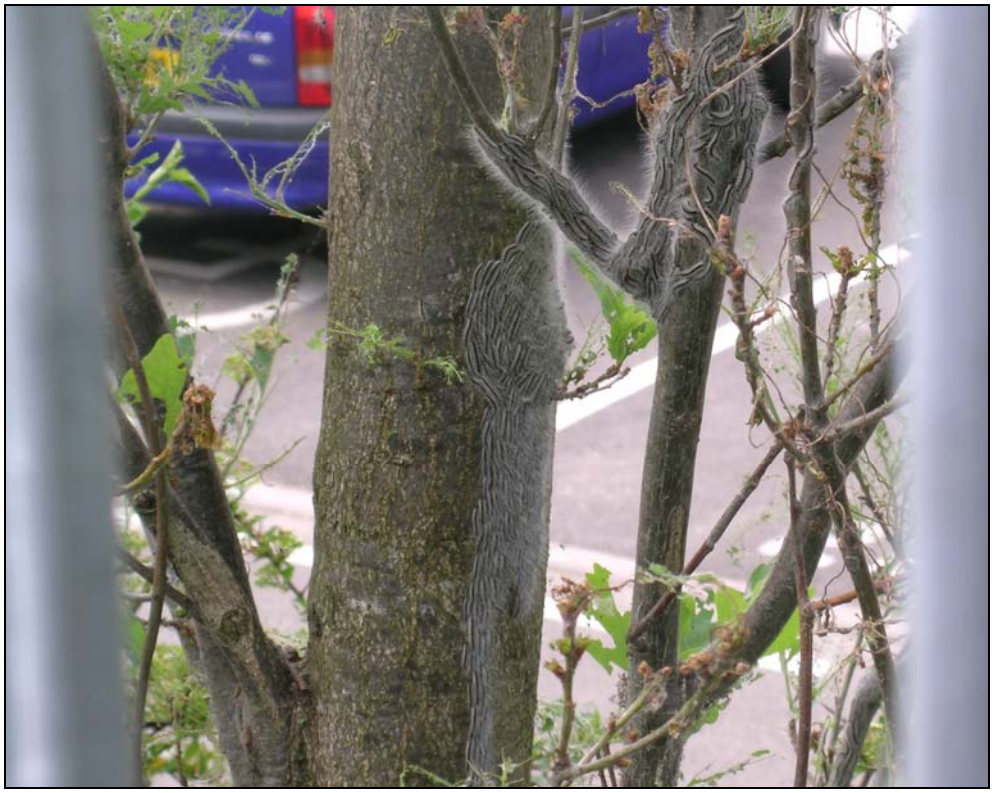

Figure 3. Small Fastigiate Oaks at an infestation site in 2007. Tree centre right with feeding damage and larvae present. Tree centre left in poor condition after infestation in 2006 (and may also be suffering from other sources of stress, such as drought). St. James Estate, Richmond May 3rd 2007 (photo M. Townsend).

Figure 4. Nest (arrowed) roughly 1.5m above wooden bench in open parkland. Syon Park, Hounslow 25th July 2007 (photo M. Townsend).

3. METHODS

3.1 Tree inspections

Trees were inspected visually from the ground for nests and feeding damage (see section 2.4.1). Binoculars (8 x 42) were used to inspect higher branches and confirm identity. Trees were inspected from all possible angles to ensure good coverage. Inspections were only carried out in favourable light and were not carried out in rain. For larger trees, it was sometimes found that due to the angle of the sun it was not possible to carry out an adequate inspection. In these cases, a further inspection was made at a different time of day (i.e. one was made in the morning and one in the afternoon). A bicycle was often used as transport between sites, especially for scattered street trees and surveys of peripheral areas for which no information was obtained.

Numbers of nests, their size, height and position in the tree, and any larval activity were recorded. Location of infested trees (10-figure OS grid reference) was recorded using GPS. All surveys on private land were carried out with the permission of the landowner, with the exception of one small site in Ealing, the ownership of which could not be established. Here, access was made under the Plant Health Order and after consultation with the Forestry Commission, after nests of OPM were seen on the site from outside the boundary fence. Notes were made on the distribution of non-infested trees, with the location of isolated specimens recorded on GPS.

3.2 Collaborations

Surveys, mainly of street trees were also carried out by staff from Ealing, Brent and Richmond Borough Councils. Metronet and Tubelines carried out surveys of railway embankment under their jurisdiction. Advice and training on search methods were given as required, and surveys were carried out working closely with these organisations and individuals. Wider searches were targeted at concentrations of oaks and used information gathered from borough councils, including street trees. Reported sightings received via local contacts and from Forest Research were followed up by site visits.

The request for records of OPM and brief summary of the situation placed in the entomological journal *The Entomologists Record and Journal of Variation* in 2006, was repeated in 2007 in the *Entomologists Gazette*. Other lepidopterists, including national recorders of immigrant lepidoptera, were asked to report sightings. A number of unconfirmed reports were received by Forest Research following publicity and information on their website, and these were followed up by site visits where appropriate.

During investigations regarding the 2006 discoveries, information was received that a number of Fastigiate Oaks, imported as semi-mature trees had been planted as part of recent landscaping beside the slip road from the M25 motorway to Terminal 5 of Heathrow Airport. Subsequently, contact was made with the landscapers, DHA Landscaping (access is restricted by airport and motorway regulations), and a site visit was made on 1st June with the landscapers. No evidence of OPM was observed.

3.3 Use of the Plant Health (Forestry) Order 2005

Private landowners were served with a Notice under Article 31(4) of the Plant Health (Forestry) Order 2005 requiring them to remove nests using appropriate methods and within a prescribed timeframe, and guidance was provided. Information was provided as soon as possible to councils and landowners in order to facilitate rapid nest removal and ensure that as far as possible, removal took place before the flight period of the moth. Leaflets and other information were also provided freely to landowners and managers where OPM was not found, for possible future reference and as part of dissemination of information. In this respect, Ealing BC leafleted all houses in the Borough.

3.4 Pheromone traps

Pheromone traps were placed at some sites in conjunction with a survey of a wider area in and around the affected boroughs carried out by Forest Research. Intensive pheromone trap surveys were carried out by RBGK, and the railway trackside maintenance companies Metronet and Tubelines. In most cases, cardboard fold-out Delta traps were used, roughly 30cm long with a sloping roof, supplied by *Oecos*. The traps incorporate a rubber bung impregnated with pheromone (the lure), which is suspended from a small plastic hanger inside the trap. The insects are caught on a sticky surface inserted into the base of the trap. AtRBGK, "bucket"-type traps from a Belgian supplier were also used alongside the Delta traps. Traps were hung from oak trees at a height of 3-5m and remained *in situ* for the whole flight period of the moth.

4. RESULTS

- An estimated 708 nests were found, 534 in Ealing/Brent (458 in Ealing, 76 in Brent), 174 in Richmond and 3 in Hounslow. Tree climbers destroying nests often found additional nests not visible from the ground. Some totals may include a small number of nests from last year.

- Searches were made over a wide area of Ealing, extending into Brent; Richmond, extending to a wide area of Chiswick and the southern part of Hounslow. At both epicentres, nests were concentrated in a fairly localised area, with few outliers. Most inspections were made of trees in public areas and commercial premises (with permission). Trees in private residential gardens were only inspected from public areas. Ealing Council invited local residents to request a tree inspection if they had an oak tree on their private property and Ealing's Tree Service carried out 32 such inspections in early July 2007.

- Generally, landowners and managers were cooperative and willing to take the necessary measures to control OPM on their sites. However, the speed of response varied considerably as did the level of coverage and accessibility and the methods used. As far as is known, almost all (>99%) nests located were destroyed before the flight period of the moth. In some cases, it was not possible to check due to access restrictions, which was less than ideal since detailed information on nest locations was not provided in all cases. Risk assessments and PPE differed between sites, sometimes giving cause for concern. No serious health problems were reported from any companies involved in removal, but a small number of rashes were experienced.

- No OPM were trapped by Delta traps. Delta traps were placed at regular intervals on rail embankments in Ealing by Metronet and Tubelines, and in a much wider grid by Forest Research. These also failed to trap any OPM. RBGK ran both Delta traps and bucket-type traps from a Belgian supplier and caught 31 OPM, all in the latter. It is not yet known whether the results from the Delta traps were the result of a technical failure, but this is being investigated by Forest Research in consultation with the manufacturers.

- A single adult male was caught in a mercury vapour light at the London Wetland Centre (Martin Honey, pers. comm.) on 31st August and another was found at rest by day at Richmond BC offices (Shaun Case, pers. comm.) near a security light. Single males were also found at these locations in previous years in the same circumstances. Unconfirmed reports received by Forest Research and through entomological journals were followed up, and no evidence of OPM was detected outside the London Boroughs of Brent, Ealing, Richmond and Hounslow.

- 100+ Cypress Oaks on the slip road from the M25 to Terminal 5 of Heathrow Airport were examined, but no signs of OPM were found. Landscape staff had not seen any sign of OPM in 2006, nor did they report any symptoms likely to have been caused by OPM.

5. ACKNOWLEDGMENTS

A large number of people have been involved with this work, to whom the author is most grateful. The major roles of staff from Richmond and Ealing Borough Councils, Royal Botanic Gardens Kew and the Forestry Commission were particularly vital to the success of the work.

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