

SCIENTIFIC NOTES

INTRODUCTION AND ESTABLISHMENT OF *Aedes (Stegomyia) albopictus* SKUSE (DIPTERA: CULICIDAE) IN ALBANIA

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ABSTRACT. In August–October 1979, infestations of the mosquito *Aedes albopictus* were discovered at a number of widely separated sites in Albania. Used tires were the principal larval habitat. The species was probably introduced from China in the mid-1970s. The initial infestation was probably at a rubber factory adjacent to the port of Durrës (Durazzo), from where the mosquito was shipped in tires to recapping plants in other parts of the country. This is the first recorded infestation of *Ae. albopictus* outside Oriental and Australasian regions.

KEY WORDS *Aedes albopictus*, used tires, Albania

Albania (Albanian name, Shqipëria; latitude, 39°38'N to 42°39'N; longitude, 19°18'E to 21°04'E; area, 28,748 km²; population [1990], 3.26 million) is a republic on the western shore of the Balkan Peninsula, across the Adriatic/Ionian Sea from the heel of Italy (Fig. 1) Seventy percent of the terrain is mountainous, with a mean altitude of 708 m. Summers are hot and dry. In lowland areas (below 300 m altitude), mean daily temperatures range from 23°C to 26°C in July and August. Winters are harsh and cold, with frequent subzero temperatures except in the coastal regions. The capital, Tirana (Albanian name, Tiranë; 41°21'N, 19°50'E; population [1990], 253,000), is at the edge of the coastal plain, 27 km from the sea.

On August 8, 1979, the Kërkimor Institute of Hygiene and Epidemiology received complaints that large numbers of black-and-white mosquitoes were biting voraciously in broad daylight at a truck autoparc⁴ in Laç, a small town on the northern coastal plain (Fig. 1). On investigation, it appeared that these mosquitoes were particularly abundant around a large pile of used tires, most of which contained water infested with mosquito larvae. Larvae were also found in adjacent drums and other

containers. The mosquito was identified (Adhami and Murati 1987) as *Aedes (Stegomyia) albopictus* Skuse, a species native to Asia. We report here on subsequent surveys and observations made in various parts of the country.

In the months after the initial discovery, surveys were conducted in all the low-altitude districts of the country and in 2 major autoparcs at high altitude, Pogradec (altitude 700 m) and Korçë (altitude 800 m). *Aedes albopictus* was found in 6 towns: Laç, Milot, Shkodër, Krutjë, Durrës, and Tirana. The species was also present at a dump for discarded tires in Xibrakë (41°09'N; altitude 250 m), 2.5 km from the nearest human habitation (Fig. 1). The most northerly infested town was Shkodër (42°5'N, altitude 12 m), 20 km from the coast and 10 km from the border with Montenegro (previously part of Yugoslavia). As in Laç, larvae were mostly found in tires, but other containers such as barrels, 0.5-liter glass preserve jars, cooking pots, and even discarded bottles were also infested. The mosquito was particularly common in the gardens of periurban homes. Container indices for tires and other containers are listed by species in Table 1.

Employees at the autoparc were emphatic that the problem had been with them for at least 4 years. Rice-field mosquitoes are common in the area, but none fit their description of "a black-and-white mosquito that attacks in the day time." This, and the fact that the mosquito was already abundant at several sites throughout the country, indicates that the species may have been introduced at least as early as 1975.

Until its appearance in Albania, *Ae. albopictus* had only been reported in the Oriental and Australasian regions (Stone et al. 1958, Hawley 1988). Since then, however, established infestations have been reported in 12 countries throughout the world (Reiter 1998). The rapid expansion of the range of this species has been attributed to a worldwide trade in used tires made possible by containerization and other innovations of the transportation industry (Reiter and Darsie

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⁴ Until recently, Albania had a centralized economy. Every vehicle was the property of the State and was allotted to a specific autoparc, according to the relevant branch of the economy.

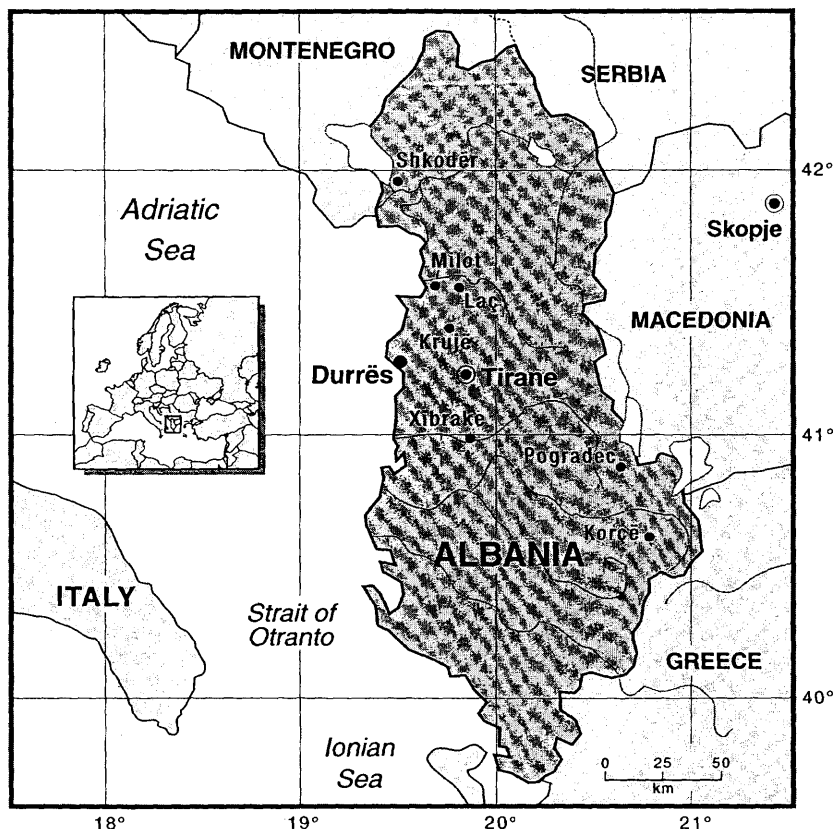


Fig. 1. Sites infested with *Aedes albopictus* in Albania, August–October 1979.

1984, Reiter and Sprenger 1987). However, to our knowledge, no used tires were ever imported into Albania, so we must presume that the species arrived in some other item or items of cargo.

Apart from Albania, Italy is the only country in Europe with known infestations of *Ae. albopictus*. The species first appeared in Genoa in 1990 (Raineri et al. 1991) and to date has extended its range as far south as Naples (39°50'N) and Cagliari (39°13'N) on

the island of Sardinia (della Torre et al. 1992, Romi 1995). However, despite the chronology of its appearance and the geographic proximity of the 2 countries, it is unlikely that the Italian infestation originated in Albania. Until 1980, Albania's principal trading partner was China, and no records exist of used tire exports from Albania to Italy. In addition, good evidence exists that the Italian infestations originated in the United States (Dalla Pozza and Majori 1992, Dalla Pozza et al. 1994), although the numbers of used tires imported from Japan and the United States are roughly equal (Reiter 1998).

Our survey indicated that Durrës, the principal point of entry for goods from China, was the only infested seaport. Close to the docks was a rubber factory devoted, among other things, to the recapping of used tires. On the factory premises was a pile of thousands of used tires. Several contained water and mosquito larvae, most of which were *Ae. albopictus*. In the same area was a hangar used to store recapped tires prior to their transport to other parts of the country. We examined 60 of these tires and found one with *Ae. albopictus* larvae, and 3 others with *Ae. albopictus* adults.

A population of *Ae. albopictus* was monitored at an infested site near Tirana from October 1990 to

Table 1. Container indices for tires and other infested receptacles, by species, in areas infested with *Aedes albopictus*.

| Species | Tires | Other containers |
|------------------------------------|-------|------------------|
| <i>Aedes albopictus</i> | 56.0 | 34.6 |
| <i>Aedes geniculatus</i> | 8.0 | 0 |
| <i>Anopheles claviger</i> | 0 | 0.3 |
| <i>Anopheles maculipennis</i> s.l. | 0 | 0.6 |
| <i>Anopheles plumbeus</i> | 11.4 | 0 |
| <i>Culex hortensis</i> | 0.07 | 2.0 |
| <i>Culex pipiens</i> s.l. | 21.4 | 56.8 |
| <i>Culex territans</i> | 0.5 | 0 |
| <i>Culex theileri</i> | 0.1 | 1.4 |
| <i>Culiseta annulata</i> | 2.5 | 4.2 |
| <i>Culiseta longiareolata</i> | 0.0 | 0.02 |

May 1991. Females continued biting until the end of October, but no eggs appeared in ovitraps after the week of October 11–18. The last larvae of the season were 2 in the 4th instar that were found in a barrel on December 12. In the following year, the 1st larvae appeared on April 30, in tires exposed to the sun. The 1st eggs were collected in ovitraps exposed in the period May 16–20, and the 1st females were captured to human bait on May 20. These observations indicate that, as in other temperate latitudes, the Albanian *Ae. albopictus* population survives because the eggs are cold-hardy and have a winter diapause mechanism that limits hatching to the warmer months of the year (Hawley et al. 1987). Indeed, Tirana (41°21'N) is close to the latitude of Chicago (41°53'N) and Beijing (39°55'N), both of which are at the northern extreme of the range of *Ae. albopictus* (Hawley 1988).

Until the malaria eradication campaigns after World War II, *Aedes aegypti* (L.), the principal urban vector of dengue and yellow fever, was present throughout the Mediterranean region (Christophers 1960), including Albania (Marcuzzi 1943). Indeed, in the years 1927–1928 one of the largest outbreaks of dengue and dengue hemorrhagic fever ever recorded occurred in Greece, with a million cases and 1,000 deaths (Copanaris 1928), most of them in Athens (37°58'N, 22°43'E) and Thessalonika (40°38'N, 22°56'E). For this reason, the establishment of *Ae. albopictus* in Albania is cause for concern, for in rural areas of Southeast Asia and on some oceanic islands it is important as a dengue vector (Metselaar et al. 1980, Hawley 1988). Even in areas where *Ae. aegypti* is the dominant vector, *Ae. albopictus* may serve as a maintenance vector during non-epidemic periods because of its ability to transmit virus transovarially (Rosen et al. 1983). Moreover, laboratory studies have shown that the species is capable of transmitting a number of other arboviral diseases (Gubler and Rosen 1977; Shroyer 1986; Mitchell et al. 1987; Mitchell 1991, 1995; Turell et al. 1992).

In October 1979, the Institute of Hygiene and Epidemiology recommended a series of measures to minimize production of *Ae. albopictus*. The most effective measure has been storage of used tires in stacks that shelter each layer of tires from the next to prevent accumulation of rainwater. This approach has resulted in a marked reduction of the *Ae. albopictus* population in autopaes and their surroundings.

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REFERENCES CITED

- Adhami, J. and N. Murati. 1987. Prani e mushkonjës *Aedes albopictus* në Shqipëri. [Presence of the mosquito *Aedes albopictus* in Albania]. Rev. Mjekësore 1:13–16. [In Albanian.]
- Christophers, Sir S. R. 1960. *Aedes aegypti* (L.) The yellow fever mosquito. Its life history, bionomics and structure. Cambridge Univ. Press, Cambridge, United Kingdom.
- Copanaris, P. 1928. L'épidémie de dengue en Grèce au cours de l'été 1928. Bull. Off. Intern. Hyg. Pub. 20: 1590–1601.
- Dalla Pozza, G. L. and G. Majori. 1992. First record of *Aedes albopictus* establishment in Italy. J. Am. Mosq. Control Assoc. 8:318–320.
- Dalla Pozza, G. L., R. Romi and C. Severini. 1994. Source and spread of *Aedes albopictus* in the Veneto region of Italy. J. Am. Mosq. Control Assoc. 10:589–592.
- della Torre, A., C. Bomboi and G. Cancrini. 1992. Estensione dell'areale di *Aedes albopictus* in Italia. Primo reperto della specie in Italia centrale. [Extension of the range of *Aedes albopictus* in Italy. First report of the species in central Italy.] Parassitologia 34:143–146. [In Italian.]
- Gubler, D. J. and L. Rosen. 1977. Quantitative aspects of replication of dengue viruses in *Aedes albopictus* (Diptera: Culicidae) after oral and parenteral infection. J. Med. Entomol. 13:469–472.
- Gutsevich, A., A. Monchadsky and A. Stackelberg. 1970. Komari, Semejstvo Culicidae. [Mosquitoes, Family Culicidae]. Nauka, Leningrad, Soviet Union. [In Russian.]
- Hawley, W. A. 1988. The biology of *Aedes albopictus*. J. Am. Mosq. Control Assoc. 1(Suppl.):1–40.
- Hawley, W. A., P. Reiter, R. S. Copeland, C. B. Pumpuni and G. B. Craig, Jr. 1987. *Aedes albopictus* in North America: probable introduction in used tires from northern Asia. Science. 236:1114–1116.
- Huang, Y.-M. 1976. The mosquitoes of Polynesia with filariasis and/or dengue fever. WHO/FIL/76.143 and WHO/VBC/76.654.
- Lee, K. and J. Lien. 1970. Pictorial keys to the mosquitoes of Korea. WHO/VBC/70.196.
- Marcuzzi, G. 1943. Note sui Culicidi dell'Albania. [Note on the Culicidae of Albania.] Riv. Parassitol. 7:155–167. [In Italian.]
- Metselaar, D., C. R. Grainger, K. G. Oei, D. G. Reynolds, M. Pudney, C. J. Leake, P. M. Tukei, R. M. D'Offay and D. I. H. Simpson. 1980. An outbreak of type 2 dengue fever in the Seychelles probably transmitted by *Aedes albopictus*. Bull. WHO 58:937–943.
- Mitchell, C. J. 1991. Vector competence of North and South American strains of *Aedes albopictus* for certain arboviruses: a review. J. Am. Mosq. Control Assoc. 7:446–451.
- Mitchell, C. J. 1995. Geographic spread of *Aedes albopictus* and potential for involvement in arbovirus cycles in the Mediterranean Basin. J. Vector Ecol. 20:44–58.
- Mitchell, C. J., B. R. Miller and D. J. Gubler. 1987. Vector competence of *Aedes albopictus* from Houston, Texas, for dengue serotypes 1 to 4, yellow fever and Ross River viruses. J. Am. Mosq. Control Assoc. 3:460–465.
- Raineri, V., G. T. Trovato, A. Sabatini and M. Coluzzi. 1991. Ulteriori dati sull' diffusione a Genova di *Aedes albopictus*. [Recent data on the infestation of Genova with *Aedes albopictus*.] Parassitologia 33:183–185. [In Italian.]
- Reiter, P. 1998. *Aedes albopictus* and the world trade in used tires, 1988–1995: the shape of things to come? J. Am. Mosq. Control Assoc. 14:83–94.
- Reiter, P. and D. F. Darsie, Jr. 1984. *Aedes albopictus* in Memphis, Tennessee (USA): an achievement of modern transportation. Mosq. News 44:396–399.
- Reiter, P. and D. Sprenger. 1987. The used tire trade: a mechanism for the world-wide dispersal of container

- breeding mosquitoes. *J. Am. Mosq. Control Assoc.* 3: 494-501.
- Romi, R. 1995. History and updating on the spread of *Aedes albopictus* in Italy. *Parassitologia* 37:99-103.
- Rosen, L., D. A. Shroyer, R. B. Tesh, J. E. Freier and J. C. Lien. 1983. Transovarial transmission of dengue viruses by mosquitoes: *Aedes albopictus* and *Aedes aegypti*. *Am. J. Trop. Med. Hyg.* 32:1108-1119.
- Shroyer, D. A. 1986. *Aedes albopictus* and arboviruses: a concise review of the literature. *J. Am. Mosq. Control Assoc.* 2:424-428.
- Stone, A., K. Knight and H. Starke. 1959. A synoptic catalog of the mosquitoes of the world (Diptera, Culicidae). The Thomas Say Foundation, Washington, DC.
- Turell, M. J., J. R. Beaman and R. F. Tammariello. 1992. Susceptibility of selected strains of *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae) to chikungunya virus. *J. Med. Entomol.* 29:49-53.