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BUTTERFLIES FROM THE UJUNG KULON NATIONAL PARK, INDONESIA

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ABSTRACT. Butterflies found on the Ujung Kulon Peninsula (85 spp.) and Pulau Peucang (36 spp.) in 1984 are listed and compared with the fauna of the Krakatau Islands. Many species are limited to particular vegetation types or ecotones, and maintenance of habitat diversity appears vital to ensure continued diversity in the national park. At present, management for grazing by large mammals and limited human access are practical conservation measures for butterflies.

Additional key words: Java, surveys, conservation, biogeography.

The Ujung Kulon Peninsula and adjacent islands comprise the westernmost region of Java, Indonesia. Since the large-scale inundations by tsunamis associated with the eruption of Krakatau in 1883, this region has been largely free from human activities. It is now a national park to which access is strictly controlled and monitored, and in which scientific work may be undertaken only by permit. Land access is difficult, and most visitors arrive by boat from towns on the NW coast of Java and stay predominantly on Pulau Peucang (Fig. 1). The main purpose of this park, which comprises some 30,000 ha, is to foster the last remaining population of the Javan rhinoceros, *Rhinoceros sondaicus sondaicus* Desmarest, but the relatively undisturbed forest and other vegetation types render it one of the most significant areas in Java for the conservation of native fauna. Much of the forest survived the 1883 catastrophe, but little forest now present is considered to be true mature lowland rainforest (Blower & van der Zon 1977). The latter occurs on Gunung Payung, the highest point of the western part of the park, and on the nearby island of Pulau Peucang (Fig. 1). Much of the rest of western Java has undergone considerable change in support of a burgeoning human population, and there is little doubt that the Ujung Kulon National Park now harbors remnant populations of many taxa

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which were formerly much more widespread. In common with much of the "third world", the distribution of reserves tends to reflect human settlement patterns, but the significance of Ujung Kulon was recognized by bestowal of the status of "nature reserve" in 1921 (Hoogerwerf 1970). Since that time it has been upgraded to a national park, and Ujung Kulon has become "the most widely known conservation area in South East Asia" (Blower & van der Zon 1977). It assumes additional biogeographical importance as a likely major source area of animals and plants that have reached the Krakatau Islands over the last century since life there was expunged in 1883.

In 1984, La Trobe University and the Bogor Zoological Museum mounted a joint expedition to survey the fauna of the Krakatau Islands, some 60 km N of the Ujung Kulon Peninsula, but politically part of the same national park. Nearly 30 biologists participated in the expedition (Thornton 1985, Thornton & Rosengren 1987). An auxiliary aim was to examine the biota of selected areas bordering the Sunda Strait to assess likely origins of the Krakatau fauna. Ujung Kulon is one such area. This paper is an appraisal of the butterflies collected and seen there during the expedition.

METHODS

A total of 158 biologist-days was spent in the Ujung Kulon area from 30 August–23 September 1984. Slightly under half of these (73 biologist days) were on Pulau Peucang (Fig. 1), an island of ca. 440 ha separated from the peninsula by ca. 500 m of shallow water. The various sites visited on the W part of Ujung Kulon are shown in Fig. 1. They include a range of representative vegetation types: Pulau Peucang—pes-caprae formations, *Ficus* forest, and various edge habitats; Ujung Kulon—pes-caprae, mangrove, *Radermachera* forest, *Arenga* forest, forest edges, and *Chrysopogon* grassland. Plant nomenclature is based on papers in Flenley and Richards (1982).

Most records are of butterflies collected by the authors, but many other expedition members also contributed specimens. TRN and MBB systematically searched the above-noted vegetation types to observe relative abundance of the species present. Examples of the taxa collected will be deposited in the Museum Zoologicum Bogoriensis, Bogor. Identification was from published literature (including Corbet et al. 1978 and papers referred to therein), and by comparison with collections in Bogor and the British Museum (Natural History), except for Hesperiidae, which were identified by A. F. Atkins. Although Blower and van der Zon (1977) refer to "large entomological collections" from the area, we have not traced any previous lists of butterflies from Ujung Kulon.

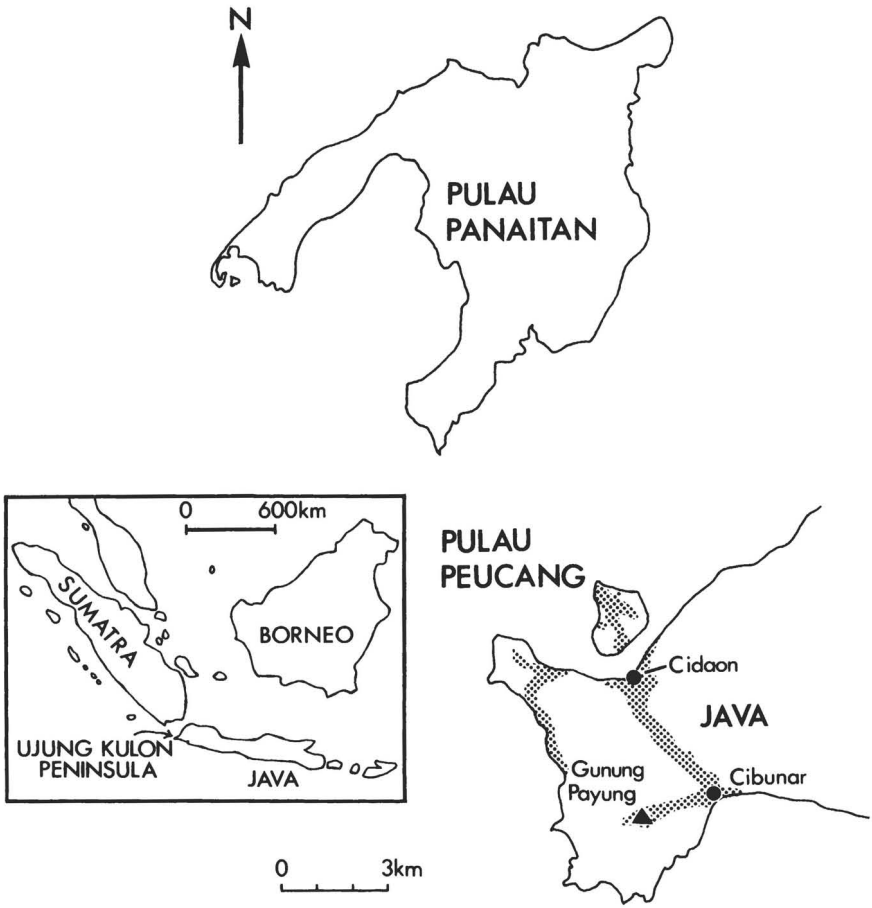

FIG. 1. Western part of Ujung Kulon peninsula, Java, indicating areas (shaded) where collections were made and locations mentioned in text. Sunda Strait passes between Sumatra and Java, and the Krakatau Islands are in the center of the Strait 60 km N of Ujung Kulon.

RESULTS AND DISCUSSION

Although the butterfly fauna of Indonesia is reasonably well known, at least in gross terms, there are few lists of species in areas of particular biological significance. The fauna of the Krakatau Islands has received much recent attention (Yukawa 1984, Bush 1986, New et al. 1987), and Yukawa (1984) also noted 29 species from Pulau Panaitan, an island of slightly over 12,000 ha separated from Ujung Kulon by ca. 10 km of deep water, and not visited by us. The data presented here thus complement Yukawa's account and, although the species list (Table 1)

TABLE 1. Butterflies recorded in Ujung Kulon Peninsula and Pulau Peucang in 1984 including records in Pulau Panaitan from Yukawa (1984) and incidence of species on the Krakatau Islands.

	Ujung Kulon	Pulau Peucang	Pulau Panaitan	Krakataus
Papilionidae				
Pachliopta aristolochiae antiphus (F.)	X			X
P. a. adamas (Zinken)	X	X		X
Atrophaneura coon coon (F.)	X			
Graphium agamemnon agamemnon L.		X	X	X
G. doson evemonides Honrath	X	X	X	
G. macareus macareus (Godart)	X			
Papilio peranthus peranthus F.		X	X	
P. helenus engarius Doherty	X		X	
P. polytes? *javanus* Felder	X			
P. antiphates Cramer ssp.?	X			
P. memnon anceus Cramer	X	X		X
Pieridae				
Appias indra leptis (Felder)	X		X	
A. lyncida lyncida (Cramer)			X	
A. nero nero (F.)			X	
A. paulina (Cramer)	X		X	
Catopsilia pomona F.	X	X	X	X
Ceporea idith (F.)	X		X	
Eurema blanda (Boisduval)	X	X	X	X
E. hecabe (L.)	X	X		X
Leptosia nina (F.)	X	X		
Gandaca harina harina (Horsfield)	X	X	X	
Pareronia valeria leona (Fruhstorfer)	X		X	
Saletara liberia panda (Godart)	X			
Hebemoia glaucippe (L.)	X			
Danaidae				
Euploea camerelzeman Butler	X			
E. crameri Lucas		X	X	
E. diocletianus F.	X			
E. mulciber mulciber (Cramer)	X	X		
E. m. donada Fruhstorfer	X			
E. modesta Butler			X	
E. leucostictos leucostictos Gmelin	X			
E. tulliolus (F.)		X		
Radena juventa (Cramer)	X	X		X
Tirumala limniace (Cramer)	X			
Nymphalidae				
Agatasa franck Godart	X			
Athyma nefte subrata Moore f. *neftina* (Fruhstorfer)		X		
Cethosia penthesilea methypea (Butler)	X			
C. hypsea Doubleday			X	
C. sp.?		X		
Charaxes sp.			X	
Chersonesia rahria (Moore)	X		X	X
Cirrhochroa tyche (C. & R. Felder)			X	X
Cupha erymanthis lotis (Sulzer)	X	X		
Cyrestis thermire Honrath	X			

TABLE 1. Continued.

	Ujung Kulon	Pulau Peucang	Pulau Panaitan	Krakataus
Doleschallia bisaltide pratipa (C. & R. Felder)	X			
Euthalia evelina sikandi (Moore)	X			
E. mahadeva (Moore)			X	
Hypolimnas anomala anomala (Wallace)	X			X
Lebathea martha malayana Fruhstorfer	X			
Lexias dirtea (F.)	X			
Neptis hylas (L.)	X	X	X	X
N. sankara (Kollar)	X			
Pantoporia paraka (Butler)	X			
Phalanta alcippe (Stoll)	X	X		
Precis atlites L.	X	X		X
P. almana javana C. Felder	X			
P. erigone (Cramer)	X			
P. hedonia ida (Cramer)	X			
P. iphita (Cramer)	X			
Tanaecia clathrata (Vollenhoeven)	X			
T. godartii (Gray)	X			
T. iapis (Godart)	X			
T. munda Fruhstorfer	X	X		
Terinos terpander ?teos (de Niceville)	X	X		
Satyridae				
Melanitis leda (L.)	X	X		X
M. phedima (Cramer)	X			
Elymnias hypermnestra (L.)	X			X
Lethe confusa Aurivillius	X			
Mycalesis horsfieldi (Moore)	X			X
M. janardana Moore	X			X
Ypthima horsfieldi Moore	X			X
Faunis canens canens Hübner		X		
Lycaenidae				
Liphyra brassolis Westwood	X			
Arhopala antimuta C. & R. Felder	X			
Allotinus horsfieldii Moore	X	X		
A. subviolaceus C. & R. Felder		X		
A. unicolor C. & R. Felder	X			
Catochrysops panormus (C. Felder)			X	X
C. strabo (F.)	X	X		X
Chilades pandava (Horsfield)		X		
Drupadia ravindra Distant	X	X		
Eooxylides tharis distanti Riley	X			
Ionolyce helicon (C. Felder)	X			
Jamides bochus (Stoll)			X	X
J. aratus (Stoll)	X	X		X
J. celeno (Cramer)	X	X		X
J. elpis (Godart)	X			
J. parasaturatus (Fruhstorfer)	X			
J. malaccanus (Röber)			X	
Lampides boeticus (L.)	X	X		X
Miletus ?boisduvali Moore	X			X
M. sp.			X	

TABLE 1. Continued.

	Ujung Kulon	Pulau Peucang	Pulau Panaitan	Krakataus
Nacaduba pactolus (C. Felder)			X	
Neopithecops zalmora (Butler)	X	X		
Pithecops corvus Fruhstorfer	X			
Prosotas nora superdates Fruhstorfer	X			
P. dubiosa (Semper)			X	
Zizina otis (F.)	X	X		X
Zizula hylax (F.)	X			X
Hesperiidae				
Halpe pelethronix Fruhstorfer	X			
Koruthaialos rubecula namata Fruhstorfer	X			
Isma bononia bononia (Hewitson)	X			
I. obscura vulsina Evans	X			
Sancus (Psolos) fuligo fuligo (Mabille)	X			
Telicota colon vaja Corbet	X			
Zographetus (Ogygia) ogygioides Elwes & Edwards	X			
Salanoemia tavoyana Evans	X			
Acerbas anthea javanica Snellen		X		
Taractrocera? aliena aliena (Plötz)		X		
Potanthus confucius (C. & R. Felder)			X	X

cannot be regarded as comprehensive, it will be of value for comparison with other sites in Indonesia as the fauna is progressively documented.

In Table 1, the species are noted as occurring either on Ujung Kulon proper or on Pulau Peucang. Yukawa's (1984) Pulau Panaitan records are also included, and incidence of species on the Krakatau Islands is indicated.

At least 106 species of butterflies are here recorded from Ujung Kulon and nearby islands; the several noted merely as "sp." are not included in this total because of possible overlap. This figure represents some 18% of the 583 species recorded from Java (Yukawa 1984), and includes representatives of all families except Libytheidae (3 Javanese species) and Riodinidae. The relatively small size of Pulau Peucang rendered our coverage reasonably complete, and the 36 species recorded there are believed to well represent the butterflies then flying on the island.

Vegetation of Ujung Kulon is diverse (Hoogerwerf 1970, Blower & van der Zon 1977, Hommel 1983), and offers a wide range of habitats for butterflies: beach forests with pes-caprae formations, mangrove swamp forests, freshwater swamp forests, and rain forest, and artificially maintained clearings and grasslands.

Distribution of many butterfly species was limited, and clearly related to predominant vegetation types. The pes-caprae formations take their name from *Ipomoea pes-caprae* (L.) R. Br., a common creeper on

accreting tropical beaches growing in association with a mixture of grasses and herbaceous dicotyledons. The pes-caprae formations of both Pulau Peucang and Ujung Kulon were rich in *Jamides* spp., *Catochrysops* spp. and *Eurema* spp. *Catochrysops strabo* (F.) was the commonest of the lycaenids in this association on both Pulau Peucang and Ujung Kulon, a finding which contrasts markedly with its apparent absence from Pulau Panaitan (Yukawa 1984) where its place appears to be filled by *C. panormus* (C. Felder). Both *C. strabo* and *C. panormus* were recorded on the pes-caprae formations on Krakatau, but both were relatively scarce there, and *Jamides celeno* (Cramer) and *J. aratus* (Stoll) were the predominant species. Further work is necessary to establish the seasonality of these species before a significant distribution pattern can be discerned.

The narrow belt of mangroves at Cidaon supported few butterfly species. Those seen flying there, including *Papilio helenus engarius* Doherty and *Melanitis phedima* (Cramer), seldom settled, possibly having strayed from the nearby forest edge.

The forests of Pulau Peucang and Ujung Kulon differ widely in character. Those of the former appear to be more mature, and are dominated by large individuals of *Ficus pubinervis* Bl. and strangler figs, which form a canopy at ca. 30–35 m. The canopy produced by these species is dense; little light reaches the forest floor, and there is very little undergrowth between the widely spaced trunks. Only *Terinos terpander ?teos* (de Niceville) and *Melanitis leda* (L.) were recorded within this forest. However, where trees had fallen, creating an opening in the canopy, *Phalanta alcippe* (Stoll) and *Drupadia ravindra* Distant were present. This forest is in some ways comparable to the *Ficus pubinervis* forest of Rakata, Krakatau. On Rakata the *F. pubinervis* forest is not so well established, and there is a dense undergrowth of pteridophytes and *Smilax zeylanica* L. The last is a forest creeper which has been suggested as the foodplant of the only deep-forest butterfly on Krakatau, *Loxura atymnus fuconius* (Stoll) (Bush 1986). Notably, neither *L. atymnus* nor *S. zeylanica* were recorded during our visit to Pulau Peucang.

One similarity between the forests of Krakatau and Pulau Peucang is the lack of impact of footpaths. On the latter, the trunks of trees are so widely spaced that there has been no need to fell trees to create paths, and thus the canopy remains unbroken. Krakatau has no footpaths; the only clearings are where trees have fallen. This contrasts with Ujung Kulon where the denser forest growth necessitated limited clearing for footpaths. The result is the creation of forest "rides", where more light reaches the forest floor. If the butterflies found along these forest paths are used as an indication of the overall species composition

in forest areas, two points must be borne in mind. First, there is an increased butterfly population taking advantage of the flush of herbaceous growth along the footpath, and this might give a misleading impression of the density of butterfly populations. Second, there is the problem of dissociating those species which are true deep-forest butterflies (and have been found by chance along the ride) from those species which are woodland-edge species and would not be found there but for the increased light availability. An impression of butterfly numbers and species diversity in the true forest can only be obtained away from the paths.

Butterflies which seemed to be characteristic of the Ujung Kulon forest interior were *Pithecops corvus* Fruhstorfer, *Arhopala antimuta* C. & R. Felder, *Agatasa franck* Godart (the last seen roosting high on tree trunks), and locally *Lexias dirtea* (F.) (found only on the higher slopes of Gunung Payung (480 m)).

The forest edge habitat on Pulau Peucang was probably oversampled compared with other areas, as the clearing surrounding the park office bungalows where we were based was the nearest and easiest area to collect in. Pink and red-flowering garden shrubs attracted a variety of danaids including *Euploea crameri* Lucas, *E. mulciber mulciber* (Cramer) and *Radena juventa* (Cramer). Another common visitor to these shrubs was *Papilio peranthus peranthus* F., although it appeared to be scarce in the rest of the reserve, and was not recorded at all from Ujung Kulon. *Graphium agamemnon* L., *Precis atlites* L. and *Neptis hylas* (L.) were among other heliophilous species recorded in the clearing.

Forest-edge areas on Ujung Kulon are a varied set of habitats determined by the surrounding forest type. There is additional habitat diversity created by stream banks. Many species were collected along forest paths, or in clearings where trees had fallen. Some of those that may be true forest species were *Leptosia nina* (F.), *Allotinus* spp., *Lebathea martha malayana* Fruhstorfer (?), and members of the *Euthalia-Tanaecia* complex. Species that seemed more light-demanding recorded along paths were *Hebemoia glaucippe* (L.), *Appias* spp., *Atrophaneura coon coon* (F.) and *Ypthima* spp. Many Pieridae were captured on flowers or at streamsides; the most abundant were *Eurema* spp. and *Catopsilia pomona* F., the latter migrating at the time of our visit (New et al. 1985). The various species of *Appias* were all taken in open glades or at the edge of the forest where, like *H. glaucippe*, they visited flowering shrubs. Although some of the pierids were caught near streams, there were no marked concentrations of butterflies on stream banks.

In Ujung Kulon the extensive *Chrysopogon* grassland communities maintained for herds of banteng, *Bos javanicus* (d'Alton), did not ap-

TABLE 2. Numbers of butterfly species shared between areas of western Java and the Krakatau Islands.

	Ujung Kulon	Pulau Peucang	Pulau Panaitan	Krakatau Islands
Ujung Kulon	—	24	11	22
P. Peucang	—	—	8	15
P. Panaitan	—	—	—	9
Total	85	36	29	54

pear to support a rich butterfly fauna. This, however, may have been due to cloudy conditions when collecting was carried out on the main grassland area at Cidaon. The abandoned field systems around Cibunar were rich in flowering herbs such as *Eupatorium odoratum* L., which attracted *Neptis* spp. and *Pachliopta aristolochiae* (F.).

The eight species of Hesperiidae recorded from Ujung Kulon were captured along forest tracks or at the forest margin. None was taken on the grassland expanses of Cidaon or Cibunar. These are all woodland or semi-woodland species. The eight species of Hesperiidae from Krakatau were caught in grassland or beach habitats, and habitat preferences may thus account for the lack of overlap of species between the two localities.

One butterfly recorded regularly on Krakatau (and also at Carita, W. Java) was *Troides helena* (L.). However, neither *T. helena* nor the closely related *T. cuneifer* (Oberthür) were recorded from Ujung Kulon or associated islands. *Delias* spp., which might have been expected in the forests at Ujung Kulon, were notably absent. This genus was also absent from Krakatau, but there the reason is likely to be the absence of the foodplants (Loranthaceae).

Degrees of overlap of species found on Ujung Kulon, Pulau Peucang, Pulau Panaitan, and the Krakatau Islands are shown in Table 2. Many of the 54 species found in recent collections from Krakatau (New et al. 1987) were not found in the Ujung Kulon area.

Tables 1 and 2 should be interpreted with caution as the survey of Ujung Kulon was far from complete, and the low values obtained from Pulau Panaitan suggests that it, too, may have been undersampled. It is likely that all the species found on Pulau Peucang and Pulau Panaitan are present on Ujung Kulon even though they were not recorded during this census. From the data available, the degrees of species overlap of Ujung Kulon with Pulau Peucang and Krakatau are almost equal. However, the species are not the same in each case. Fourteen species have been recorded as common to all three localities. These species are either highly mobile-migratory or inhabit the coastal vegetation and pescaprae associations. *Radena juventa*, *Neptis hylas* and *Catopsilia po-*

mona which are geographically widespread or migratory, tend to be polyphagous, and are, therefore, likely to be successful colonizers. Species that may be more specific in their foodplant requirements, including the species of the pes-caprae formations, must rely on their habitat being present at a new site if colonization is to be successful. In coastal species, two factors aid dispersal to islands. First, they are likely to be blown out to sea, and second, the plants adapted to beach environments are likely to be among the first colonizers of an island where plant recolonization is taking place. Thus the foodplants are available for the coastal butterfly species on their arrival. Woodland butterfly species may have to arrive many times before they find a suitable habitat. This might help to explain the apparent paucity of woodland butterfly fauna on the offshore islands considered in this paper compared to the diverse species list for forest edges and coastal environments.

Particular families also overlap. As already noted, there was no overlap between the Hesperiidae of the Krakatau Islands and those of Ujung Kulon, and yet five out of eight species of satyrids found on Ujung Kulon were also found on Krakatau. In all the areas visited the commonest member of the Satyridae was *Melanitis leda*.

Many Lycaenidae were captured in small numbers, and because of the existence of species complexes, exact identification is not always clear. A single specimen of *Liphyra brassolis* Westwood is of interest, as this species is apparently rare in much of Indo-Malaya (Corbet et al. 1978). Miletinae were represented by species of *Allotinus* and *Miletus*, and Polyommatinae were by far the most diverse group of lycaenids present. The species shared with the Krakatau Islands are predominantly those associated with lowland Leguminosae, including the pes-caprae coastal vegetation which is also an important butterfly habitat on the Krakatau Islands (Bush 1986, New et al. 1987). Theclinae were relatively scarce, although one species of the complex genus *Arhopala* was found; the single species of *Eooxylides* and *Drupadia* are both widely distributed in Sundaland, but have not been found on Krakatau.

Hesperiidae can be identified only with some reservations. Only females of *Taractrocera a. ?aliena* (Plötz) were taken, for example, and male genitalia are necessary for confirmation of species identification. Most of the species records are based on single individuals.

CONCLUSIONS

All the butterfly species captured are likely to be resident in the area, and the vegetational diversity is clearly sufficient to support an enormous spectrum of Lepidoptera. The range from mature forest to cleared ground provides a diversity of successional stages. The present conser-

vation policy of maintaining cleared areas for grazing by banteng helps to foster such diversity. It has been suggested that there should be a management policy to create forest glades to provide improved grazing for the Javan rhinoceros. Such areas would also help to maintain butterfly diversity, but felling would have to be done with sensitivity to leave areas of mature forest for species that are dependent on deep-forest habitat. However, as Hommel (1983) suggests, clearings are produced naturally when giant forest trees fall. This natural process, combined with maintenance of the footpath system, could provide habitats similar to those advocated by Schenkel et al. (1978) without recourse to more active management. Further study is needed to determine the distribution of particular butterfly species on Ujung Kulon, but this brief survey, although restricted to the western region of the park, indicates that some species may be both rare and localized. Butterfly diversity in this area may well depend on the maintenance of the greatest possible range of vegetation types.

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