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Chances and Limits of Floristic Island Inventories – the Dionysades Group (South Aegean, Greece) Re-visited

By

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Summary

BERGMEIER E. & DIMOPOULOS P. 2001. Chances and limits of floristic island inventories – the Dionysades group (South-Aegean, Greece) re-visited. – Phyton (Horn, Austria) 41(2): 277–293, 1 figure. – English with German summary.

A new, annotated and critical flora inventory for the three South Aegean Dionysades islands is presented, differentiated for each island, and based on 240 own vascular plant records and all available data from literature. The total list for the island group comprises now 277 species of which 51 are reported for the first time. *Astragalus sesameus* was found new for the South Aegean (Cretan area), and *Medicago arborea* is new to the native flora of wider Crete. The distribution of *M. arborea* and other cliff species into phryganic habitats on the two major islands was not noticed by previous researchers and is, since grazing by domestic herbivores was given up, probably a rather recent phenomenon. A comparison between the first (GANDOGER, ca. 1917) and our recent records (in 2000) revealed few cases of taxa which are now likely to be extinct. They are weeds that bear witness of former local cultivation on the two bigger islands. The great majority of the new findings is not owing to recent establishment but to previous observation gaps. There is but one clear case of recent introduction: *Oxalis pes-caprae*. The question is raised whether conventional species census is an adequate tool for island monitoring. It is suggested to install and perform a more consistent and standardized way of island monitoring, including appropriate sampling on community and population level.

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Zusammenfassung

BERGMEIER E. & DIMOPOULOS P. 2001. Möglichkeiten und Grenzen bei der floristischen Erforschung von Inseln – die Dionysaden-Gruppe (Süd-Ägäis, Griechenland) neu untersucht. – Phyton (Horn, Austria) 41(2): 277–293, 1 Abbildung. – Englisch mit deutscher Zusammenfassung.

Auf der Grundlage von 240 eigenen Nachweisen und allen verfügbaren Literaturdaten wird ein neues, kommentiertes und kritisches Verzeichnis der Gefäßpflanzen der südägäischen Dionysaden-Inselgruppe vorgelegt, mit Einzelangaben für jede der drei Inseln. Die Florenliste umfasst 277 Arten, von denen 51 neu für die Inselgruppe sind. *Astragalus sesameus* ist neu für die Südägäis, und *Medicago arborea* wird erstmals als indigene Art im Gebiet Kretas (einschließlich vorgelagerter Inseln) nachgewiesen. Die Ausbreitung von *M. arborea* und anderer Kliffspezialisten in Phrygana-Habitate wird von früheren Bearbeitern nicht erwähnt und ist wahrscheinlich ein junges Phänomen seit der Aufgabe der Weidenutzung. Ein Vergleich zwischen den ersten Pflanzennachweisen (GANDOGER, um 1917) und unseren (2000) zeigt, dass seither offenbar nur wenige, nämlich ruderale Arten, Zeugen des früheren Feldbaus auf den beiden größeren Inseln, ausgestorben sind. Ein Vergleich der Liste von CHRISTODOULAKIS & al. 1990 mit unserer legt nahe, dass die große Mehrheit der Neunachweise auf Beobachtungslücken und nicht auf kürzlicher Etablierung beruht. Letztere ist nur für *Oxalis pes-caprae* anzunehmen. Es wird bezweifelt, dass konventionelle Artenzählungen für ein Insel-Monitoring methodisch angemessen sind, und daher vorgeschlagen, sie um standardisierte Probenahmen auf Gesellschafts- und Populationsebene zu ergänzen.

1. Introduction

The Dionysades Islands, 7–12 km off the north coast of eastern Crete, harbour a considerable number of Aegean endemic and other rare plant species, and they are also significant for a unique herpeto- and ornithofauna. The islands were consequently included in the European network of conservation areas, 'Natura 2000', currently under construction (DAFIS & al. 1996). It was in this framework that our fieldwork on the Dionysades was made possible, with the task of sampling and mapping the vegetation. A floristic inventory was also made, as a by-product of our investigations on all and all over the three islands, Janisada, Dragonada, and Paximada. Some geographic parameters of the Dionysades are summarized in Table 1; Fig. 1 shows the position of the archipelago. More details are available in the account of CHRISTODOULAKIS & al. 1990, together with an outline of the islands' phytogeography and vegetation.

Previous floristic data on the Dionysades had been sampled by GANDOGER in 1917 and by RECHINGER in 1942, and were published by RECHINGER 1943a, 1943b, 1951 and in various later revisional contributions. RUNEMARK and co-workers, on their visits in 1960 and 1962, and GREUTER in 1966, collected a limited number of specimens from Janisada and Dragonada. Their materials were to a major extent published by GREUTER 1973a and in various monographs and revisional papers, including GREU-

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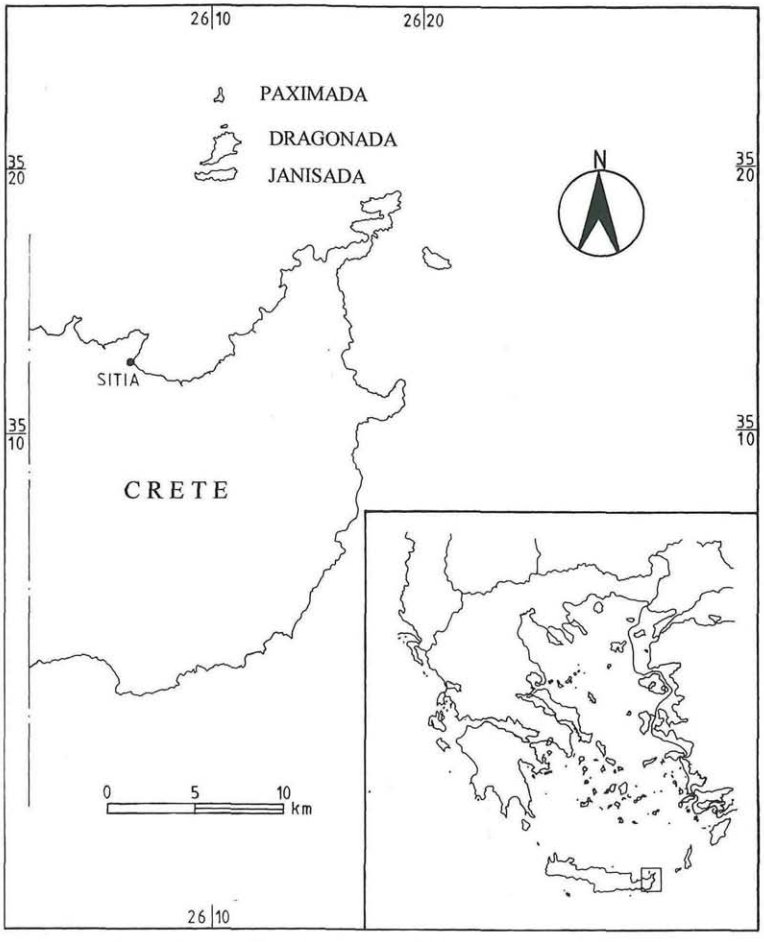

Fig. 1. Geographical position of the Dionysades Islands.

Table 1

Some geographic parameters of the Dionysades islands.

Island	Area (ha)	Altitude (m)	Max. extension (km)	Geology	Nearest distance to Crete (km)
Janisada	208	150	3,2	Plattenkalk	7
Dragonada	284	125	3,5		8,5
Paximada	30	136	1,25	Phyllite	12

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TER 1968, 1973b, STRID 1970, STORK 1972, BOTHMER 1974, RUNEMARK 1980, SNOGERUP & al. 1990, MEUSEL & KÄSTNER 1990. In 1987/88, a group of botanists from the University of Patras visited the three islands, attempting to provide a full floristic inventory subsequently published by CHRISTODOULAKIS & al. 1990. Later, KYPRIOTAKIS 1998 added a short list of records from Paximada. Our own fieldwork was in March/May 2000 (Table 2).

Table 2

Botanical research on the Dionysades islands in the 20th century. J = Janisada, D = Dragonada, P = Paximada.

Researcher	Year	Month/Day	Islands
GANDOGER	ca.1917	?	J, D
RECHINGER	1942	5/13-14	J, D, P
RUNEMARK & NORDENSTAM	1960	7/4	D, P
RUNEMARK & S. SNOGERUP	1962	5/19	J, (D, P)
GREUTER	1966	10/31	J, D
CHRISTODOULAKIS, GEORGIADIS, IATROU	1987	9/26-27	J, D, P
ECONOMIDOU, GEORGIADIS, IATROU	1988	4/2	
KYPRIOTAKIS	? (-1997)	?	P
BERGMEIER & DIMOPOULOS	2000	3/29	J
BERGMEIER	2000	3/31+5/11	D, P

A broad range of floristic studies presenting Aegean island inventories has accumulated which may be used in general-purpose island biogeography as well as in the field of regional phytogeography (GREUTER 1991, 1995; STRID 1996). To date, however, there are only few examples of repeated floristic investigations on Mediterranean islands (SNOGERUP & SNOGERUP 1987, RAUS 1988, HÖNER 1991), although species inventories that permit comparison along the time scale are urgently needed if questions concerning dynamics and turnover are to be addressed.

The Aegean archipelago has been termed a "natural laboratory" for studies on biogeography and speciation (GREUTER 1995, STRID 1996). Our new data on the uninhabited Dionysades, together with the materials taken from previous accounts, may serve as an example, along which the chances and limits of current floristic island census in the Aegean and elsewhere may be discussed.

In the present paper, the following questions are addressed:

1. Is there evidence for species turnover on the Dionysades in the course of the 20th century?
2. Are the available data sufficient for numerical comparison of island floras in space and time?
3. Is the species census an appropriate tool for island monitoring?

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2. Methods

We visited Janisada on March 29, 2000, Dragonada on March 31 and May 5, and Paximada also on May 5, 2000. The time was limited and chiefly spent for vegetation sampling but floristic recording was performed simultaneously. The collections (73 vouchers) were stored in the herbarium of the first author, with the exception of that of *Astragalus sesameus* which was given to the Botanische Staatssammlung München (M). A full list of our vascular plant taxon records of the Dionysades was provided, specified for each island and author, and all available data from literature were included. Literature data were critically reviewed, i.e., all data were taken into consideration, and records considered unlikely were discussed but not used for the numerical evaluation. The latter is based on accepted taxa on the levels of species and subspecies. The nomenclature of the taxa follows JAHN & SCHÖNFELDER 1995, except for the genera *Prospero* and *Charybdis* (SPETA 2000, 2001). The island names in the list are abbreviated by the first letter J, D, P, and the authors/collectors as follows: G – GANDOGER; R – RECHINGER; Ru – RUNEMARK & NORDENSTAM, RUNEMARK & SNOGERUP; Gr – GREUTER; Ch – CHRISTODOULAKIS, GEORGIADIS, ECONOMIDOU, IATROU & TZANOUDAKIS; K – KYPRIOTAKIS; B – BERGMEIER & DIMOPOULOS. Records based on our collections are indicated by!.

3. Floristic Inventory of the Dionysades Islands

The list is arranged with the major groups in systematic order, and the families and species in alphabetic order. The names of unlikely literature records not accepted by us are in square brackets. Synonyms from literature and misapplied names (the latter in inverted commas) are given if used by CHRISTODOULAKIS & al. 1990.

Pteridophyta
Sinopteridaceae
Cheilanthes acrostica ("*C. pteridioides*") – J [Ch,B!]; D [Ch,B]
Cosentinia vellea (*Cheilanthes vellea*) – J [Ch]

Gymnospermae
Cupressaceae
Juniperus phoenicea – J [B]; D [G,R,Ch,B]

Angiospermae, Dicotyledones
Aizoaceae
Mesembryanthemum nodiflorum – D [R,Ch]; P [R,Ch,B]

Anacardiaceae
Pistacia lentiscus – J [B]; D [G,R,Ch,B]

Boraginaceae
Anchusa aegyptiaca – J [R,Ch,B]; D [G,Ch,B]; P [Ch]
Buglossoides arvensis – J [B!]
Echium angustifolium – J [B]; D [G]
Echium arenarium – D [R,B]; P [Ch,B!]
Echium parviflorum – J [R]; D [G,B]
Neatostema apulum – J [R,B];D [B]

Campanulaceae
Campanula erinus – D [G,Ch]
[*Campanula spatulata* subsp. *sprunerana* was given for Janisada by

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RECHINGER 1943a, based on a GANDOGER record; considered erroneous by CHRISTODOULAKIS & al. 1990 and presumed to be *C. spatulata* subsp. *filicaulis*, but neither taxon was found since GANDOGER. In fact, the occurrence of *C. spatulata* s.l. on the Dionysades islands is unlikely, and the species should be regarded as absent.]

Capparaceae

Capparis spinosa subsp. *rupestris* – D [G,CH,B]; P [R,CH, K,B!]

Caryophyllaceae

Arenaria aegaea – J [RU,CH]; D [CH]; P [K]

Dianthus fruticosus subsp. *amorginus* – J [Ru]; D [Ru,GR]; P [K,B!]

Herniaria hirsuta – D [CH,B]; in the absence of a herbarium specimen, the identity of the *Herniaria* species on Dragonada remains to be confirmed.

Paronychia macrosepala – J [G,R,CH,B]; D [G,R,CH,B]

Polycarpon tetraphyllum – J [B]; D [G,CH,B]; P [CH,B]

Sagina maritima – P [R]

Silene apetala – D [B]

Silene dichotoma – J [G]; since GANDOGER the species was never observed again. It is now absent on the islands and may have had the status of a casual weed on Janisada.

Silene gallica – J [CH]

Silene nocturna – J [B]; D [B]

Silene sedoides – J [R,B]; D [R,CH,B]; P [R,CH,B!]

Silene vulgaris subsp. *macrocarpa* – J [R]; D [B]

Stellaria pallida – D [B]

Chenopodiaceae

Arthrocnemum macrostachyum – J [CH,B]; D [R,CH,B]; P [R,CH, K,B!]

Atriplex halimus – J [R,CH,B]; D [G,R,CH,B]; P [R,Ch, K,B]

Atriplex recurva – P [R,CH]

Chenopodium murale – J [B]; D [R,CH,B]; P [CH,B]

Chenopodium opulifolium – D [G]; the species was never observed by later botanists and seems to be absent from the Dionysades islands today.

Salsola aegaea – P [R,CH, K,B!]

Salsola carpatha – J [G,CH]; D [G,CH,B!]; P [RU,CH, K,B!]

[*Sarcocornia fruticosa* was recorded from Paximada by RECHINGER 1951, however, its presence in the Cretan area is not sufficiently documented and since misidentification with *Arthrocnemum macrostachyum* is quite possible, the record was not included in the map provided by TAN 1997.]

Suaeda vera – P [R,CH,B!]

Cistaceae

Cistus creticus – D [CH]

Fumana arabica – J [CH,B]; D [CH,B]

Fumana thymifolia – J [CH,B]; D [G,B]

Helianthemum salicifolium – J [R,CH,B]; D [R,CH,B]

Tuberaria guttata s.l. – J [CH]

Compositae

Aetheorhiza bulbosa subsp. *microcephala* – J [B]; D [G,B]

Anthemis ammanthus subsp. *ammanthus* – J [G,R,RU,CH,B]; D [R,RU,CH,B!]; P [R,CH,K,B!]

Atractylis cancellata – J [R,CH,B]; D [R,CH,B]

Calendula arvensis – D [B]; P [CH]

Carlina diae – J [GR]; D [RU,GR,CH,B!]

Carlina graeca (*C. corymbosa* subsp. *graeca*) – J [G,CH,B]; D [G,CH,B]

Chrysanthemum coronarium – D [G,B]

Cichorium pumilum – D [R]

Crepis commutata – J [B]; D [G]

Crepis cretica – J [G,R,CH,B]; D [G,CH,B]

Crepis multiflora – J [G,R]; D [G,R,B]; P [B]

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Crupina crupinastrum – D [B]
Cynara cornigera – J [R,CH,B]; D [G,R,CH,B]
Filago aegaea subsp. *aegaea* – J [G,B]; D [R,B!]
Filago pygmaea – D [CH]
Hedypnois rhagadioloides – J [CH,B]; D [G,CH,B]; the plants found may be assigned to subsp. *tubaeformis* (given by CHRISTODOULAKIS & al. 1990: 431) and to subsp. *monspeliensis*.
Helichrysum conglobatum (*H. barrelieri*) – J [CH,B]; D [G,CH,B]
Hyoseris scabra – J [CH,B]; D [CH,B]
Hypochaeris achyrophorus – J [G,CH,B]; D [CH,B]; P [CH]
Lamyropsis cynaroides – D [CH]
Leontodon tuberosus – J [G,CH,B]; D [G,CH,B]
Phagnalon graecum – J [CH,B]; D [R,CH,B!]; P [CH, K,B]
Ptilostemon chamaepeuce – J [GR]
Reichardia intermedia – J [B]
Reichardia orientalis – J [R, RU,CH,B!]; D [R,CH,B]; P [R,CH,B!]
Reichardia picroides – J [G]; D [B]
Rhagadiolus stellatus – D [CH]
Scolymus hispanicus – J [R,CH]
Senecio gnaphalodes – D [RU, B!]
Senecio leucanthemifolius ("*S. gallicus*") – J [B]; D [R,CH,B!]; P [CH,B]
Senecio pygmaeus – J [B]; this taxon which was known in regional literature for the western part of Crete only, is treated as a variety of *S. leucanthemifolius* by ALEXANDER 1979 but differs clearly in leaf shape, absence of ligulate florets, and quantitative characters of the calyculus and phyllaries. No intermediates were seen in co-occuring populations elsewhere in Crete.
Senecio vulgaris – J [B]; D [B]
Sonchus oleraceus – J [B]; D [G,CH,B]; P [CH, K,B]
[*Sonchus tenerrimus*; due to frequent confusion with forms of *S. oleraceus* the record for Dragonada (RECHINGER 1943b) needs confirmation.]
Tragopogon sinuatus – J [B]; D [CH, B]
Urospermum picroides – J [R,B]; D [G,CH,B]; P [B]

Convolvulaceae
Convolvulus althaeoides – J [CH,B]; D [G,R,CH,B]
Convolvulus siculus – J [B!]; D [B]
Cuscuta palaestina – J [B]; D [CH,B]; P [B!]

Crassulaceae
Crassula alata – J [B]
Sedum litoreum – J [G,R,CH,B!]; D [G,R,CH,B]; P [Ch,K,B]
Sedum rubens – J [B]; D [B]
Umbilicus horizontalis – J [R, CH, B]; P [CH, B]

Cruciferae
Alyssum strigosum – J [CH,B!]
Biscutella didyma – J [CH,B]; D [CH,B]
Brassica cretica subsp. *aegaea* – J [R,RU,CH,B!]; D [RU,B]; P [CH,K,B]
[*Cakile maritima*; there is no suitable habitat (sandy beaches) for this species on the Dionysades; hence, in the absence of a herbarium specimen, the record for Dragonada (CHRISTODOULAKIS & al. 1990) is improbable.]
Clypeola jonthlaspi – J [CH, B]
Didesmus aegyptius – J [R,B]; D [B]; P [R,B]
Fibigia lunarioides – J [RU,CH]; D [GR,CH,B!]; P [RU,CH, K,B]
Malcolmia chia – J [RU,CH,B!]
Malcolmia flexuosa – J [G]; D [R,CH,B!]; P [R,CH, K,B!]
Matthiola sinuata subsp. *glandulosa* – J [GR,CH]; P [CH, K,B!]

Cucurbitaceae
Bryonia cretica – J [B]

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Ericaceae
Erica manipuliflora – D [B]

Euphorbiaceae
Euphorbia acanthothamnos – J [B]; D [G,CH,B]
Euphorbia dendroides – J [G,R,CH,B]; D [G,R,CH,B]; P [CH,B]
Euphorbia exigua – D [B]
Euphorbia peplus – J [CH,B]; D [B]
Mercurialis annua – J [CH,B]; D [G,CH,B]; P [CH,B]

Frankeniaceae
Frankenia hirsuta – J [G]; D [R,CH,B!]; P [CH, K]
Frankenia pulverulenta – D [R,CH]

Gentianaceae
Blackstonia perfoliata – J [CH]; D [CH]
Centaurium pulchellum – J [G]
Centaurium tenuiflorum – D [G,CH,B!]

Geraniaceae
Erodium cicutarium – J [CH,B]; D [B]
Erodium gruinum – D [B]
[*Erodium laciniatum*; the occurrence of this psammophilous species on Dragonada (RECHINGER 1943a, based on GANDOGER) is highly unlikely due to ecological reasons. GANDOGER might have seen *E. neuradifolium* instead.]
Erodium malacoides – J [B]; D [B!]
Erodium neuradifolium – J [CH]; D [R,CH]; P [CH,B!]
Geranium molle subsp. *molle* – J [CH]; D [G,CH]; P [CH]
Geranium rotundifolium – J [CH,B]; D [CH,B]

Labiatae
Coridothymus capitatus – J [G,R,CH,B]; D [G,R,CH,B]
Lamium amplexicaule – J [CH,B]; D [B]; P [CH]
Marrubium vulgare – D [G,B]
Prasium majus – J [B]; D [R,CH,B]; P [B]
Salvia verbenaca – J [B]; D [G,CH,B]
Salvia viridis – J [RU,CH,B]; D [G,CH,B]
Sideritis curvidens – J [R,CH]; D [G,R,CH,B]
Stachys spinosa – J [G,R,CH,B]; D [CH,B]
Teucrium brevifolium – J [R,CH,B]; D [G,CH,B]
[*Teucrium cuneifolium* was said to occur on Dragonada by GANDOGER (RECHINGER 1943a) but has never been confirmed. It might have been mistaken for *T. divaricatum* or a form of *T. gracile*. The occurrence of *T. cuneifolium* was already considered doubtful by CHRISTODOULAKIS & al. 1990.]
Teucrium divaricatum – D [B]
Teucrium gracile – J [R,B]; D [G,CH,B!]

Leguminosae
Anagyris foetida – J [B]
Anthyllis hermanniae – D [CH]
Anthyllis vulneraria subsp. *rubriflora* – D [CH]
Astragalus hamosus – J [CH,B]; D [CH,B!]
Astragalus sesameus – D [B]; first record for the Cretan area as defined by GREUTER & al. 1989, and second for the Aegean.
Bituminaria bituminosa (*Aspalthium bituminosum*) – J [B]; D [CH,B]
Calicotome villosa – D [G,CH,B]
Coronilla scorpioides – J [B]; D [CH,B!]
Genista acanthoclada – D [G,CH,B]
Hedysarum spinosissimum – D [CH,B]
Hippocrepis biflora – J [CH]; D [R,CH,B]
Hippocrepis ciliata – J [B!]; D [CH,B]
Hippocrepis cyclocarpa – D [B!]
Hymenocarpos circinnatus – J [CH,B]; D [B]
Lotus cytisoides – J [G,R,CH,B!]; D [G,R,CH,B]
Lotus edulis – J [B]; D [G,CH,B]
Lotus ornithopodioides – J [CH,B]
Lotus peregrinus – J [CH,B]; D [CH,B]
Medicago arborea – J [B]; D [B!]; this is the first record of a clearly native

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population in the area of Crete and surrounding islands.

Medicago coronata – J [CH,B]; D [CH,B]

[*Medicago littoralis*; another GANDOGER record (from Dragonada, RECHINGER 1943a) that has never been confirmed. The occurrence of this chiefly psammophilous species on the Dionysades must be considered doubtful for ecological reasons. It may well have been confused with *M. truncatula*.]

Medicago monspeliaca (*Trigonella monspeliaca*) – J [B]; D [G,R,CH,B]; P [CH,B]

Medicago orbicularis – J [CH,B]; D [CH]

Medicago praecox – J [B!]; P [CH,B!]

Medicago truncatula – J [B!]; D [B!]; P [CH,B!]

Ononis ornithopodioides – D [R,CH,B]

Ononis reclinata – J [R,CH,B]; D [G,CH,B]

Scorpiurus muricatus – J [CH,B]; D [G,CH,B]; the plants we found belong to var. *subvillosus*.

Trifolium angustifolium s.l. – J [CH]; D [B]

Trifolium campestre – J [CH,B]; D [G,R,CH,B]

Trifolium scabrum – J [B]; D [R,CH,B]

Trifolium stellatum – J [B]; D [CH,B]

Trifolium tomentosum – D [B]

Trigonella rechingeri – J [B]; D [R,CH]; P [R,CH,B!]

Tripodion tetraphyllum (*Anthyllis tetraphylla*) – J [CH]; D [B]

Vicia cretica – J [B]; D [B]

Linaceae

Linum strictum subsp. *spicatum* – J [G,CH,B]; D [G,R,CH,B]

Malvaceae

Malva aegyptia – J [R,B]; D [B]

Malva cretica – J [R,CH,B]; D [G,CH,B]

Malva parviflora – J [B]; D [R,B]; P [CH,B!]

Malva sylvestris – D [G]; never recorded since GANDOGER; the ruderal species may have been a casual introduction on Dragonada.

Orobanchaceae

Cistanche phelypaea – P [Ru]; the record was erroneously assigned to Janisada by CHRISTODOULAKIS & al. 1990.

Orobanche ramosa L. subsp. *mutelii* – J [CH,B]; D [CH,B]

Orobanche schultzii – J [Ru]; specimen (LD) seen by H. Uhlich.

Oxalidaceae

Oxalis pes-caprae – J [B]; D [B]

Papaveraceae

Fumaria macrocarpa – J [B!]; D [B]; P [B]

[*Fumaria officinalis*; the GANDOGER record from Dragonada reported by RECHINGER 1943a is doubtful. The species was never observed since and is likely to be confused with other *Fumaria* species.]

Fumaria parviflora – J [B!]

Papaver hybridum – D [G,B]

Papaver purpureomarginatum ("*P. dubium*") – J [CH,B!]; D [G]

Papaver rhoeas – J [B]; D [G]

Plantaginaceae

Plantago afra – J [CH,B]; D [B]; P [R,CH,B]

Plantago albicans – J [B]

Plantago amplexicaulis – J [R,CH,B]; D [G,CH,B]

Plantago cretica – J [B]; D [CH,B]

Plantago lagopus – J [CH,B]; D [G,R,CH,B]

Plantago weldenii – D [R,CH,B]; P [CH]

Plumbaginaceae

Limonium aucheri – J [R]

Limonium echioides – D [CH,B!]

Limonium frederici – D [B]; P [CH,B]

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Limonium graecum – J [G]; D [CH,B]; this species (but not *L. frederici*) was given for Paximada by KYPRIOTAKIS 1998; confirmation is required.

[*Limonium hyssopifolium*; there is a record from Dragonada based on GANDOGER (RECHINGER 1943a) which was never confirmed since. The species is known to be difficult to separate from *L. graecum* and *L. sitiacum* both of which occur on the island.]

Limonium sitiacum – J [R,B!]; D [R,B!]

Polygonaceae

Emex spinosa – D [B]

Rumex pulcher subsp. *woodsii* – J [B]

Primulaceae

Anagallis arvensis – J [CH,B]; D [G,CH,B]; P [CH,B]; both red- and blue-flowering (var. *caerulea*) plants were seen on Janisada. The record of *Anagallis foemina* for Dragonada by GANDOGER (RECHINGER 1943a) most probably belongs to *A. arvensis* var. *caerulea* and is assigned here.

Asterolinon linum-stellatum – J [B]; D [B]

Ranunculaceae

Adonis microcarpa subsp. *cretica* – J [B!]; D [CH]; we found yellow- and red-flowering plants on Janisada.

Anemone coronaria – J [B]; D [B]

Nigella doerfleri – J [RU,B]; D [B!]

Nigella fumariifolia – J [RU,CH]

Resedaceae

Reseda alba – J [B!]; D [B!]

Reseda lutea – J [R,CH,B]; D[G,R,CH]

Rhamnaceae

Rhamnus lycioides subsp. *oleoides* – J [G,B]; D [CH,B]

Rosaceae

Sanguisorba minor subsp. *verrucosa* – D [B]

Sarcopoterium spinosum – J [G,R,CH,B]; D [G,R,CH,B]

Rubiaceae

Asperula rigida – J [R]; D [B]

Asperula tournefortii – J [R]; P [K]

Crucianella latifolia – J [R,CH,B]; D [CH,B]

Galium aparine – J [B]; D [CH,B]

Galium graecum subsp. *pseudocanum* – J [R, RU CH]

Galium murale – J [CH,B]; D [G,B]

Galium setaceum – J [R,CH,B]; D [G,B]

Sherardia arvensis – J [CH,B]; D [CH,B]

Valantia hispida – J [G,CH,B]; D [G,CH,B]; P [B]

Valantia muralis – D [CH]; P [CH]

Rutaceae

Ruta chalepensis subsp. *fumariifolia* – J [G,CH,B!]; D [R,CH,B]

Santalaceae

Thesium bergeri – J [R]; D [B]

Thesium humile – J [B]; D [B]

Scrophulariaceae

Kickxia elatine subsp. *sieberi* – D [G]

Linaria simplex – J [B]; D [B]

Misopates orontium – J [CH,B]; D [B]

Verbascum sinuatum – J [B]

Veronica cymbalaria – J [B!]

Solanaceae

Mandragora autumnalis – J [CH,B]; D [G,CH,B]; P [CH,B]

Theligonaceae

Theligonum cynocrambe – J [CH,B]; D [B]

Thymelaeaceae

Thymelaea hirsuta – J [G,B!]; D [R,CH,B]

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Umbelliferae

Bupleurum gracile – J [RU,B]; D [B!]

Bupleurum semicompositum – J [R, RU]; D [R,CH,B!]; P [B!]

Crithmum maritimum – J [R,CH,B]

Lagoecia cuminoides – J [CH,B]; D [B]

Scaligeria halophila – J [B!]; D [R,B]

Scandix australis – J [CH,B]; D [B]

Scandix pecten-veneris – J [B]; D [CH]

Tordylium apulum – J [CH,B]; D [CH,B]

Torilis nodosa – J [G,CH,B]; D [G,CH,B]

Urticaceae

Parietaria cretica – J [G,CH,B]; D [G,CH,B]; P [CH, K,B]

Parietaria judaica – D [CH]; P [CH]

Urtica urens – D [G]; the species has never been observed since GANDOGER and is probably not present anymore on Dragonada.

Valerianaceae

Centranthus calcitrapae – J [B!]; D [CH,B]

Valerianella discoidea – J [CH,B!]; D [CH,B]

Angiospermae, Monocotyledones

Amaryllidaceae

Narcissus tazetta – J [B]; D [CH,B]

Araceae

Arisarum vulgare – J [G,CH,B]; D [CH,B]; P [CH,B]

Gramineae

Aegilops markgrafii – D [B!]

Avena barbata – J [B]; D [G,R,CH,B]; P [CH,B]

Brachypodium distachyon (*Trachynia distachya*) – J [G,CH,B]; D [CH,B]; P [CH,B]

Brachypodium retusum – J [CH]; D [G,CH,B]; P [CH]; GANDOGER recorded *Brachypodium phoenicoides* on Dragonada (RECHINGER 1943a), almost with certainty in error for *B. retusum* to which the record is assigned here.

Briza maxima – J [B]; P [CH]

Bromus fasciculatus – J [R,CH,B]; D [G,CH,B]; P [CH]

Bromus intermedius – J [G,CH,B]; D [CH,B]

Bromus madritensis – D [B]

Bromus rubens – J [CH]; P [CH, K,B]

Catapodium marinum – D [R,CH,B]; in the absence of herbarium specimens the identity of the plants assigned to *C. marinum* remains to be verified.

Catapodium rigidum – J [G,CH,B]; D [CH,B]

Dactylis glomerata subsp. *hispanica* – J [G,R,CH,B]; D [B]

Echinaria capitata – D [B]

Gastridium phleoides ("*G. ventricosum*") – J [B]; D [G,CH,B]; the genus seems to be represented on the Dionysades by *G. phleoides* only. The latter was not consistently separated from *G. ventricosum* by previous workers.

Hordeum leporinum s.l. – D [G,R,CH,B]; P [CH]; plants from Dragonada were assigned to subsp. *glaucum* (RECHINGER 1943b).

Hyparrhenia hirta – J [R,CH,B]; D [G,CH,B]

Lagurus ovatus – J [B]

Lolium temulentum – D [B]

Lolium rigidum – J [B]

Melica minuta (*M. ramosa*) – J [G,CH,B]; D [G,R,CH,B]

Parapholis marginata – D [R,CH]

Phalaris minor – J [B!]; D [G,CH,B]

Piptatherum coerulescens – J [B]; D [CH,B]

Piptatherum miliaceum subsp. *miliaceum* – J [CH,B]; D [G,CH,B]

Psilurus incurvus – J [B]; D [B]

Rostraria cristata (*Lophochloa cristata*) – J [G,CH,B]; D [G,CH,B]; P [R,CH,B]

Stipa capensis – J [CH,B]; D [G,R,CH,B]; P [CH,B]

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Iridaceae

Crocus tournefortii – J [GR]; D [B]; sterile plants seen on Dragonada were tentatively placed here.

Gynandriris monophylla – D [B]

Gynandriris sisyrinchium – J [B]; D [CH,B]

Liliaceae s.l.

Allium commutatum – J [B]; P [RU,CH]

Allium rubrovittatum – D [CH,B]

Allium tardans – J [Gr,B]; D [B]; sterile *Allium* plants seen on Dragonada were tentatively assigned to *A. tardans*; confirmation is required.

Asparagus aphyllus subsp. *orientalis* – J [B!]; D [B]

Asparagus horridus (*Asparagus stipularis*) – D [R,CH,B]; P [R,CH, K,B!]

Asphodeline lutea – D [CH]

Asphodelus ramosus (*A. aestivus*) – J [CH,B]; D [G,R,CH,B]

Charybdis maritima (*Drimia maritima*) – J [G,R,CH,B]; D [CH,B]

Colchicum spec. – D [B]; sterile plants seen have shining, up to 3 cm wide leaves.

Muscari comosum – J [B]; D [B]

Muscari dionysicum – P [R,CH,B]

Muscari spreitzenhoferi – J [R,B]; D [R,CH,B]

Ornithogalum creticum – J [R]; D [R,B!]; P [B!]

Prospero autumnale s.l. – J [B]; D [B]

Orchidaceae

Anacamptis pyramidalis – J [CH,B]; D [CH,B]

Orchis collina – J [B]; D [B]

Ophrys fusca s.l. – D [CH]

Ophrys lutea s.l. – D [CH]

4. Discussion

The fundamentals of the phytogeographic pattern in the Aegean were described for the first time by RECHINGER 1951 and later corroborated and refined by the studies of GREUTER and RUNEMARK and his co-workers. Similarly, on the Dionysades, it was also RECHINGER who was the first to provide reliable floristic data, based on GANDOGER's and his own collections and observations (RECHINGER 1943a, 1943b, 1951). RUNEMARK and co-workers, as well as GREUTER, added data chiefly on species of particular phytogeographical interest. Taxonomic and phytogeographical insight had been the scientific motive so far. In contrast, working out a full species list as was undertaken by CHRISTODOULAKIS & al. 1990 for the Dionysades, was motivated rather by the idea of providing a basis for floristic comparison, both between different islands and on the same island but between different years. The latter approach is tested here.

Table 3 shows the number of taxa recorded per island and author. The total number of vascular plant taxa currently known on the Dionysades was found to comprise 277 species. We added 51 to the 226 known from literature. The respective figures found for each island were: Janisada (213; 71 + 142); Dragonada (235; 63 + 172); Paximada (72; 9 + 63). As far as numbers deviate slightly from those given by CHRISTODOULAKIS & al. 1990, this is due to the following reasons: a small number of records from literature were overlooked by the latter authors; doubtful previous records were rejected by us; there are two more recent additions to the flora of

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Table 3

Number of taxa per island recorded per author and in total.

	Janisada	Dragonada	Paximada	Dionysades total
GANDOGER	36	78	–	97
RECHINGER	49	57	18	94
RUNEMARK & al.; GREUTER	19	8	4	26
CHRISTODOULAKIS & al.	107	145	58	188
KYPRIOTAKIS	–	–	20	20
BERGMEIER & DIMOPOULOS	174	201	53	240
Taxa total	213	235	72	277

Paximada by KYPRIOTAKIS. Floristic knowledge increased considerably along with any new study. In the first inventory (CHRISTODOULAKIS & al. 1990), 66 (42 %) taxa were found as new to the Dionysades. The respective figures found for each island were: Janisada 54 (62 %); Dragonada 55 (47 %); Paximada 39 (205 %). Our investigations resulted in another substantial increase, with 51 (23 %) new taxa for the Dionysades, 71 (50 %) for Janisada, 63 (37 %) for Dragonada, and 9 (15 %) for Paximada. Compared to the present total, the list of CHRISTODOULAKIS & al. 1990, comprises 82 % of the Dionysades flora, and 67 %, 73 %, and 83 %, for Janisada, Dragonada and Paximada, respectively.

Not surprisingly, the majority of the new records consists of small annuals. Due to the marked seasonality, such species are easily overlooked. Among these, the findings of *Astragalus sesameus* on Dragonada (first record for the Cretan area), and of *Hippocrepis cyclocarpa* (a plant of chiefly North-African distribution known in the wider area from the Karpathos archipelago and south-eastern Crete) are of particular phytogeographical interest. More surprising are the new records of as conspicuous taxa as *Pistacia lentiscus*, *Juniperus phoenicea*, *Euphorbia acanthothamnos*, *Anagyris foetida* and *Medicago arborea* for Janisada; and *Erica manipuliflora* and again *Medicago arborea* for Dragonada. Most of these records are based on only one or few individuals which were most probably overlooked, rather than established recently.

Medicago arborea deserves special attention, as no native population has ever been found before in the area of Crete and surrounding islands. On the main island, *M. arborea* is frequently planted as an ornamental and is locally naturalized. Our finding confirms the assumption of this species being native on small Aegean islands until it was distributed by man. A few shrubs of *M. arborea* were observed in the coastal cliffs of both Janisada and Dragonada. A single shrub was found on Janisada in phryganic vegetation well in front of the cliff-top, and several shrubs in similarly accessible position on Dragonada. Since both islands used to be grazed by

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domestic herbivores, and *M. arborea* being very palatable and subject to browsing whenever possible, it seems likely that the species is currently distributing from the cliff refugia into the phryganic habitats. The former effects of grazing would explain why previous researchers up to now had overlooked the attractive and conspicuous shrub.

Brassica cretica, on the Dionysades represented by subsp. *aegaea* (SNOGERUP & al. 1990), is another palatable species which is about to become a conspicuous phrygana plant while in Crete it is almost exclusively found at inaccessible sites in gorges. It is still rare in phryganic habitats in Janisada but already almost common in the western part of Dragonada. In the absence of grazing, also other species of the marine cliffs, such as *Fibigia lunarioides*, *Salsola carpatha*, *Carlina diae* and *Senecio gnaphalodes*, occur in accessible sites on top of the cliffs of western Dragonada, indicating the potential of distributing beyond their classical cliff refugia.

On the two major islands, Janisada and Dragonada, limited areas of former arable fields could be traced. The small fields are abandoned since decades but GANDOGER might have seen them cultivated. This would explain a number of weedy species recorded by him, such as *Silene dichotoma*, *Chenopodium opulifolium*, *Malva sylvestris* and *Urtica urens*, which have never been found again. GANDOGER's records are known to be not perfectly reliable but we succeeded to confirm other ruderals noted by GANDOGER, such as *Chrysanthemum coronarium*, *Marrubium vulgare*, *Papaver rhoeas* and *P. hybridum*. There is no evidence of the continuous presence of these weeds since GANDOGER's times but re-introduction seems to be a rare event which is documented for the Dionysades in only a single case here: *Oxalis pes-caprae*, with only few plants found to date.

5. Conclusions

Comparison of island floras over time, whether numerical or qualitative, requires a high degree of completeness in floristic recording, a condition which, as we found, was obviously not the case prior to the present study. The evaluation of the inventories provided by CHRISTODOULAKIS & al. 1990 and in the present paper reflects that a great many of taxa had been neglected by previous workers, rather than being turnover phenomena based on flora dynamics. On species level, numerical interpretation of the island inventories would be hazardous due to the high degree of species that may be expected to have been present but were overlooked. The reasons for this could be, seasonality of species, imcompatibility of research and optimum growth period, insufficient area-time ratio and perhaps recording knowhow. These are standardization deficits that have to be dealt with in almost any study of this kind. Conditions will rarely be as favour-

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able as with SNOGERUP & SNOGERUP 1987 and HÖNER 1991, who succeeded on the basis of two major advantages: the small size of their study areas (islets), and the field studies in different years performed by the same experienced scientists. The latter study is at the same time a good example of an extensive work based not only on floristic data but also on population dynamics.

The incompatibility of the island inventories from the Dionysades is the more irritating as we indeed found evidence for remarkable vegetation dynamics currently in progress on the Dionysades, chiefly on population and community level. For the Dionysades, as for other "natural laboratories", monitoring is required but should not be based on floristic census alone. Standardized sampling techniques are recommended (O'LEARY 1993) which may include a floristic inventory of the islands once within a 10-yr period, a carefully designed permanent-plot approach in selected plant communities to be sampled every few years, and studies on the population dynamics of selected species with different trends in population size.

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