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Species of *Nitella* (Charophyceae, Charales) from Israel: low species richness and rare occurrence

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ABSTRACT: All available specimens, published records and results of the authors' own field studies have been consulted to update information about the distribution and ecology of *Nitella* species in Israel. Study of specimens from TELA and new collections confirmed the presence of *N. mucronata* and revealed *N. hyalina* and *N. opaca*, new species for the region studied. The previous record of *N. oligospira* in Israel is quite doubtful in light of its distribution range. The ecology of *N. hyalina* and *N. mucronata* in Israel is described. There is no difference between species composition of *Nitella* in Israel and both temperate and subtropical zones of Eurasia, the former being a strongly impoverished variant of the latter two. According to the available data, low species richness and rare occurrence seem to be common features of all current data sets for *Nitella* from all other states of Western and Central Asia.

Keywords: charophytes, *Characeae*, *Nitella*, species richness, ecology, species protection, Eastern Mediterranean.

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INTRODUCTION

Our knowledge of charophytes in different regions of Western Asia varies greatly. Regional data sets with recent species records for the last decade are known only for Armenia, Cyprus, Iran, Israel, Turkey and Egypt (Sinai), mostly for Iran and Israel (Bobrov 2010; Christia *et al.* 2011; Ahmadi *et al.* 2012; Romanov & Barinova 2012; Siokou *et al.* 2013; Altinsaçli *et al.* 2014; Barinova *et al.* 2014; Barinova & Romanov 2014a,b, 2015a-g, 2016a,b; Flor Arnau 2014; Abd El Fatah *et al.* 2015; Cantonati *et al.* 2015; Noedoost *et al.* 2015). Little is known about species of *Nitella* from Israel. To date only two species were reported from a few localities, including only one contemporary record (Jones 1940; Rayss 1951; Barinova & Nevo 2010; Romanov & Barinova 2012). Recently we studied several specimens of *Nitella* stored in TELA and found new localities of occurrence. The purpose of the present work was to ascertain historical and recent *Nitella* species richness, distribution and ecology in Israel in comparison with other regions of Western Asia.

Study territory. The territory of Israel includes three climatic zones (Goldreich 2003): Mediterranean, semi-arid and arid. The main feature of the Israeli climate is that it consists of a short rainy season from December to March and a long, sunny, hot summer. The altitude of this area varies between 450 metres below sea level in the Dead Sea depression to 1200 metres above sea level in the Golan Heights, and the area is characterised by a strong gradient of temperature, precipitation and other climatic variables from north to south (Adler *et al.* 1985). On the basis of this significant spatial environmental heterogeneity, one can expect a significant diversity in the characteristics of water bodies. The existence of four plant geographical zones on the territory of Israel based on the distribution of vascular plants (Galun 1970) also favours this point of view. Such diversity of water bodies can support habitats for

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charophyte species with different ranges of environmental requirements.

One significant ecological factor affecting water bodies is the salinity gradient, which correlates with aridity of the climate. Moreover, the environment of Israel has been intensively transformed by human activity for millennia. On the one hand, this limits the opportunities for existence of charophytes, but on the other hand, artificial water bodies created by man in a given period may serve as suitable habitats for charophytes.

MATERIALS AND METHODS

The studied specimens from Dr. Y. Lipkin's collection stored in the Tel Aviv University Herbarium (TELA) were georeferenced using Google Earth. During 2001-2016, we surveyed numerous water bodies in 29 river basins, with an emphasis in recent years on localities known from published records and TELA specimens. Parallel to sampling of algae, we measured conductivity, total dissolved solids content (TDS) and pH with HANNA HI 9813; and the concentration of N-NO_3 with HANNA HI 93728. The samples were transported to the Institute of Evolution in a cool box and partly preserved in 3% formaldehyde, partly pressed and partly cultured. Cultivation was done in a greenhouse with a 12/12-h darkness/light regime at 25°C. Photos were taken using a DinoLite digital microscope or Swift and Nikon dissecting microscopes with OMAX A35100U and Leica 520 DC digital cameras. Samples of fallen oospores were taken from cultured specimens; alternatively, the darkest oospores were picked from pressed specimens. The oospore treatment protocol for SEM was described elsewhere (Romanov *et al.* 2015). Oospores were studied under a ZEISS EVO 40 scanning electron microscope (Carl Zeiss). The studied material was deposited in the Haifa University and in the Central Siberian Botanical Garden of SB RAS (NS). All specimens were studied by R. Romanov and S. Barinova. Numerous references were used for species identification (Pal *et al.* 1962; Wood & Imahori 1964, 1965; Krause 1997; Cirujano *et al.* 2008; Bazzichelli & Abdelahad 2009; Mouronval *et al.* 2015).

A synopsis of localities was compiled for the studied specimens (see accession numbers below). The localities are numbered in direction from north to the south (Figs. 1-2) and listed in chronological order. Abbreviations: YL – Yaakov Lipkin, VP – Vernon Proctor, SB – Sophia Barinova, TELA – Herbarium of Tel Aviv University, YLH – herbarium collection of Yaakov Lipkin, IEUH – collection of algae in the Institute of Evolution, University of Haifa, NS – Herbarium of the Central Siberian Botanical Garden.

RESULTS

Nitella hyalina (DC. in Lam. et DC.) C. Agardh

Description: Plants monoecious, up to 28 cm long with decaying basal parts, unbranched or scarcely branched. Old

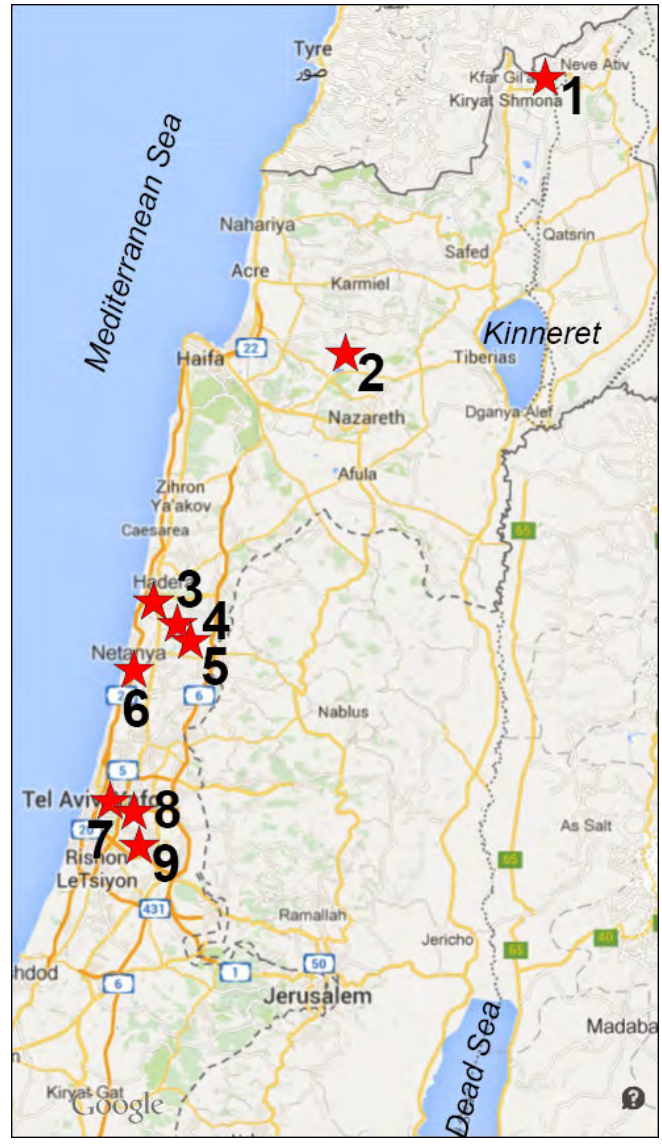

Fig. 1. Sites of waterbodies with charophytes of *Nitella* in Israel. The numbers are explained in the synopsis of localities (see text).

internodes and branchlets may be incrusted with calcite. Dactyls frequently incrusted with calcite irrespective of their age, sometimes completely. Upper parts of thalli are sometimes covered with mucus. Internodes 1.8–61 mm long, in the apical part slightly shorter than branchlets, below 2.3-8.5 times longer than branchlets Branchlets 1.7-12.3 mm long, with whorls resembling loose or dense clews, sometimes dense whorls hiding accessory branchlets and first segments of primary branchlets. The first segment is approximately 3/5 of branchlet length or shorter. Branchlets in a whorl are arranged in three rows: furcate and 2-furcate short accessory branchlets in the upper and lower rows, and 2-3-furcate long primary branchlets in the middle row. Oospores with 7-8 low ridges, 268-290 x 241-267 μ, fossa 43-47 μ wide; oospore surface sponge-like (Figs. 3-5, 6a-c). – New species record for the region studied.

Fig. 2. Sites of *Nitella* habitats in Israel: 1 – right-hand tributary of the Banias Stream, Upper Jordan basin near kibbutz Dafna; 2 – ancient site near the Eshkol Water Reservoir; 3 – quarry near Hadera train station; 4 –pools in the Brechat Ya'ar Natural Reserve; 5 – Emek Hefer old quarry; 6 – Dora seasonal pool near Netania; 7 – Yarqon River at Eser Tahanot; 8 – seasonal puddle on the Yarqon River bank.

Studied specimens: 8. Coastal Plain, Yarqon, near Tel-Aviv, Yarkon River, puddle on bank of river, N 32.06.25 E 34.50.55, alt. 14 m a.s.l. 06-XII-1950. Leg. S. Gazit. Det. YL (TELA: YLH20195, YLH20196). 9. Coastal Plain, central, Tel-Aviv, unnamed locality, ~22 m a.sl. 10-VI-1950. Leg. anonymous. Det. YL (TELA: YLH20200). 7. Coastal Plain, Yarkon River, "Eser Ha-Takhanot" [Eser Tahanot], N 32.06.19 E 34.49.38, alt. 10 m a.s.l. IX-1951. Leg. R. Dolberger. Det. YL (TELA: YLH10811, YLH10812). 2. Lower Galilee, Eshkol, Bet-Netofa valley, ancient artificial pool, N 32.47.03 E 35.15.49, alt. 150 m a.s.l. 01-VII-1966. Leg. A. Keren. Det. YL (TELA: BTN66/VII/00, x-129) YLH10524, YLH10525). 3. Hadera, old quarry near the Hadera train station, alt. 3 m a.s.l., together with *Chara vulgaris* L. 12-VI-2013 and 26-VI-2015, Leg. SB (IEUH, NS: 1971-1974).

Nitella mucronata (A. Braun) Miq. in H.C. Hall emend. Wallman

Description. Plants unincrusted, monoecious, up to 25 cm long. Branchlets 6 in a whorl, sterile branchlets 2-furcate or sometimes 1-furcate. Fertile branchlets 2-3-furcate, forming diffuse indistinct to distinct terminal heads (f. *heteromorpha* A. Braun) or do not form heads; first segment roughly equal to or slightly longer than half or up to two thirds of branchlet length, in specimens from locality 2 frequently less than half to nearly one third of branchlet length; second segments from 2 in sterile branchlets to usually 4-5 in fertile ones; dactyls 2-3, 2-celled, very rarely 3-celled; abbreviated dactyls very rarely formed, 2-3, of uneven length; end cell reduced, mucronate or penultimate cell tapering distally to base of end cell. Gametangia solitary, conjoined, located at first and second branchlet furcation. Oospores light yellow-brown with 7-8 prominent ridges, 263-305 x 258-269 µ, ~138 µ thick, fossa 50-53 µ wide; oospore surface distinctly reticulate in all studied specimens (Figs. 6d, 7-10).

Studied specimens: 4. Coastal Plain, Hadera, Berekhat Ya′ar (Birket Bteikh, Battikh), N 32.24.35 E 34.54.07, alt. 8 m a.s.l., together with *N. opaca*. 15-V-1927. Leg. N. Naftolsky (TELA: YLH20199, *Nitella*, *Tolypella*?). – A very fragmented specimen probably extracted earlier from a pressed angiosperm specimen. 4. Coastal Plain, Hadera, Berekhat Ya′ar (Birket Ata), N 32.24.35 E 34.54.07, alt. 8 m a.s.l. 18-VI-1969. Leg. YL, VP. Det. VP (TELA: (BAT69/VI/5, x-329) 20262-20267, *Nitella tenuissima*). 5. Coastal Plain, Hadera, east of "Midteshet Ruppin", Emek Hefer, artificial seasonal pool dug many years before collection, N 32.24.41 E 34.53.57, alt. 10 m a.s.l. Together with *Chara braunii*. 30-VII-1980. Leg. A. Gazit. Det. YL (*Chara braunii*). (TELA: 20778, 20779). 6. Coastal Plain, central, 3 km south of Netanya, Brekhat "Dora", Dora seasonal pool, N 32.17.28 E 34.50.49, alt. 34 m a.s.l. 05-VII-1967. Together with *Chara braunii*. Leg. YL. Det. YL (*Nitella translucens*). (TELA: (BDO67/VII/1, x-193) YLH20059-20065). Ibid. 30-VII-1980. Leg. A. Gazit. Det. YL (20780 – *Nitella*). (TELA: 20780-20782) – f. *heteromorpha* A. Braun (Fig. 10). 1. Upper Jordan Valley, Dafna, Dan (Hermon) below Dafna, tributary 2, N 33.14.04 E 35.38.12 alt. 130 m a.s.l. 12-I-2009. Leg. SB (NS: 1259). Attempts to find it at this locality in 2012, 2015 and 2016 were unsuccessful. 4. Brechat Ya'ar Natural Reserve, pool, N 32.24.35 E 34.54.07, alt. 8 m a.s.l. together with *Chara braunii* C.C. Gmelin and *Pithophora roettleri* (Roth) Wittr. 29-VI-2015. Leg. SB (IEUH, NS: 2959). – *Nitella mucronata* was reported for Israel by Rayss (1951), but voucher specimens have not been found by us. The subsequent record by Barinova & Nevo (2010) is confirmed with the specimens studied.

Nitella opaca (Bruzelius) C. Agardh

Description: Species dioecious, unincrusted fragments of female plant up to 4 cm long with small loose fructifying heads; dactyls unicellular, acute with thickened ends; oogonia from young to mature; ripe oospores from dark yellow-brown to almost black. – New species record for the region studied.

Studied specimen: 4. Coastal Plain, Hadera, Brechat Yaar (Birket Bteikh, Battikh). N 32.24.35 E 34.54.07, alt. 8 m a.s.l., together with *N. mucronata*. 15-V-1927. Leg. N. Naftolsky. (TELA: YLH 20199, *Nitella*, *Tolypella*?). A very fragmented specimen probably extracted earlier from a pressed angiosperm specimen.

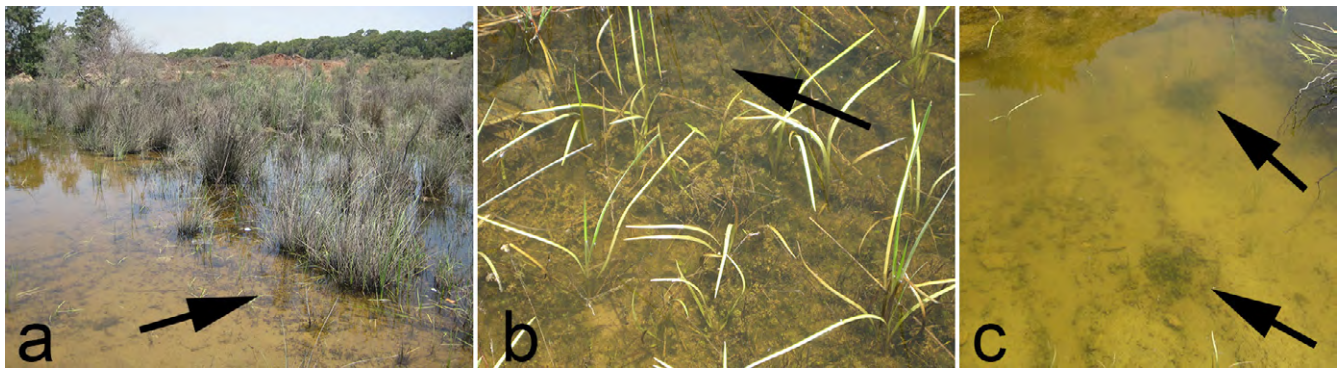

Fig. 3. Site 3, a – habitat in the old quarry near the Hadera train station, June 12, 2013; a, b – *Nitella hyalina* massive growth (black arrows); c – *Nitella hyalina* in initial stage (black arrows) in the new part of quarry at the bottom.

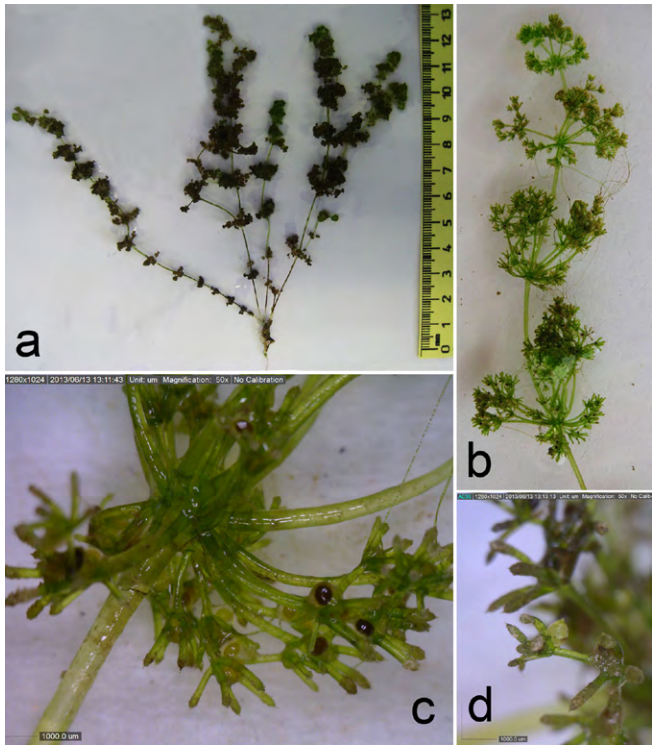

Fig. 4. *Nitella hyalina* in the old quarry near the Hadera train station (Site 3; IEUH, NS): a – total view of thallus; b – branchlets; c – branchlet with base of whorl and gametangia; d – gametangia.

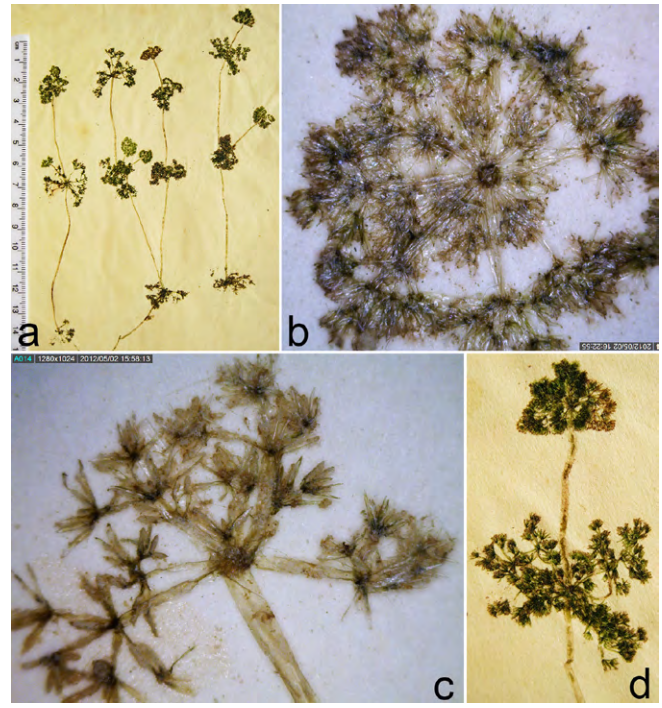

Fig. 5. *Nitella hyalina* in a puddle on the Yarqon River bank (Site 8: TELA): a – overall view of specimens; b, c – whorls of branchlets; d – upper part of thallus.

Distribution and ecology. As can be seen from the map of sampling sites (Fig. 1), most habitats are located near the Coastal Plain of the Mediterranean zone of Israel at river mouths or in ponds. Only the northern Dafna habitat is in the Hula Valley. Climatically, all of the studied sites are fairly similar, with a mean annual temperature about 20°C and rainfall of about 570 mm (http://en.climate-data.org). Notably, all of the studied *Nitella* habitats are located at low altitudes of below 150 m a.s.l. (Eshkol, Bet-Netofa valley). Hydrologically, the studied water bodies can be classified as pools or ponds with a diameter ranging from 5 m (Dafna) up to 200 m (Hadera old quarry). Water in the pools is rather transparent, up to 1 metre deep, and charophytes can be observed on the bottom (Figs. 3, 7). The Berekhat Ya′ar (Birket Bteikh, Battikh, Birket Ata) are situated in a nature reserve and represent stable ponds existing for a long time. They are important for conservation of *N. mucronata* because they support its single recent population. We did not detect any seasonality in the growth of *Nitella* populations, with records in winter, spring and summer. Water variables at the sites from which we only have dry samples from TELA collections are unknown, but we measured variables together with our samples in the last period of study. Water in recently studied pools was weakly alkaline with a pH of about 7.8, but other parameters were species-specific (Table

Table 1. Ecology of *Nitella* species from Israel, averaged data.

Species	N-NO_3, mg/l	pH	E, msm/cm	M, mg/l	T, °C	Species richness of algal community
Nitella hyalina	0.76	7.7	3.02	1499	30.6	9
N. mucronata	6.5	7.9	0.52	366	15	36

Abbreviations: E –conductivity, M – salinity, T – temperature.

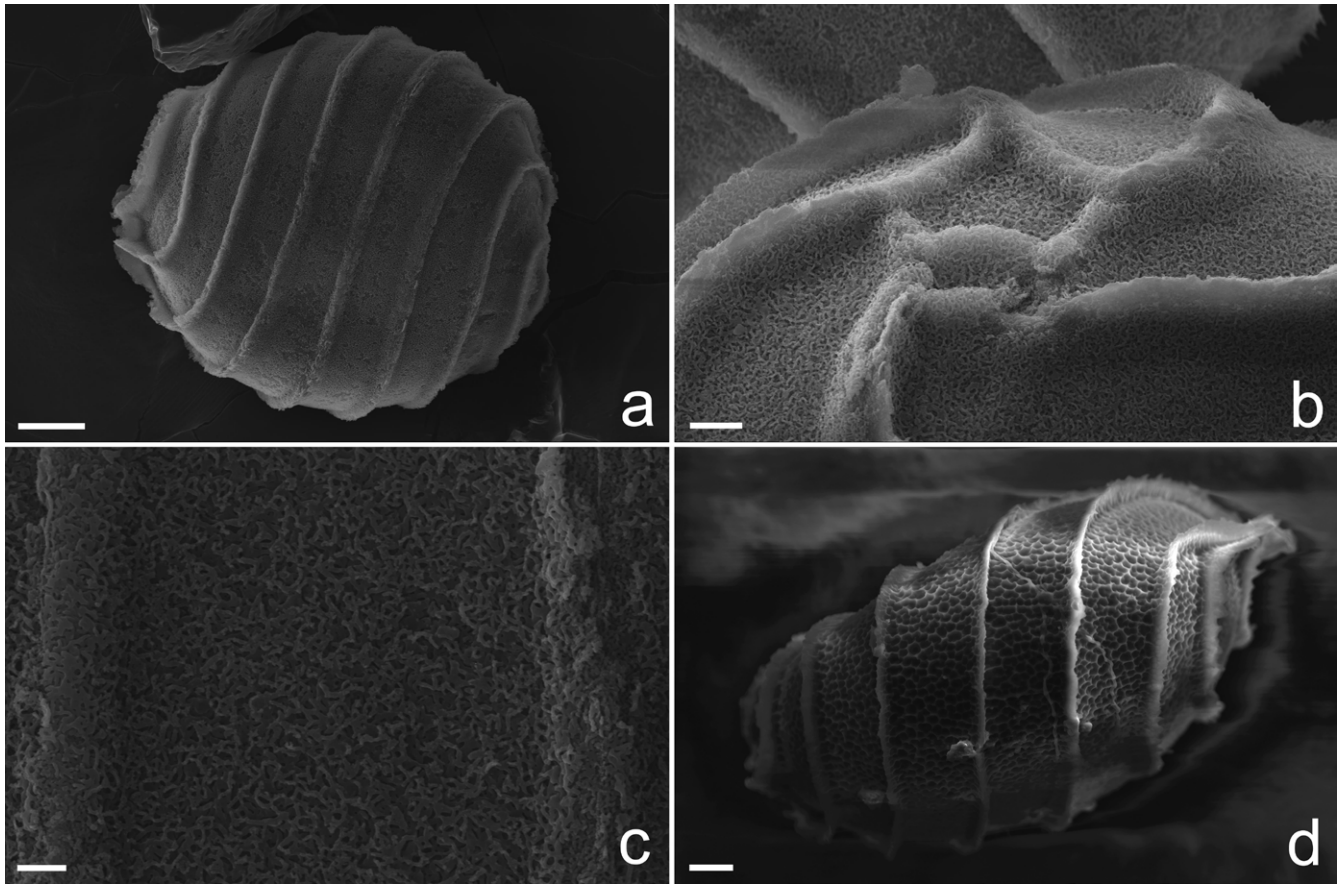

Fig. 6. Oospores of *Nitella* from Israel: a-c – *N. hyalina* (Site 3): a – frontal view, b – basal part, c – fossa; d – *N. mucronata* (Site 4), lateral view. Scale: a – 40 μm, b – 10 μm, c – 4 μm, d – 20 μm.

1). *Nitella mucronata* prefers cool, weakly mineralised, nutrient-rich water, whereas *N. hyalina* thrives in highly mineralised, warm, nutrient-poor water. Differences in habitats correlate with algal community species richness, which was low for *N. hyalina* and high – up to 36 species – for *N. mucronata*.

DISCUSSION

The new records of *Nitella* species significantly enrich the available data for Israel. Jones (1940) found *Nitella oligospira* A. Braun (reported as *N. oligospora* A. Braun) in a swamp north of Lake Hula. This species was collected before the intensive drainage of this wetland in the 1950's (Hambright & Zohari 1998). Our numerous efforts to find charophytes in the Lake Hula region were unsuccessful. Rayss (1951) reported *Nitella mucronata* from a single locality in the Hadera River. This habitat was destroyed as a result of severe pollution and now charophytes are absent in the river (Barinova *et al.* 2006). Later a new locality of *N. mucronata* in the Upper Jordan region was found (Barinova & Nevo 2010; Romanov &

Fig. 7. Site 1, a – habitat in the Banias Stream basin on Mount Hermon, view 9 March 2012; b – clump of *Nitella mucronata* in *Cladophora* bed.

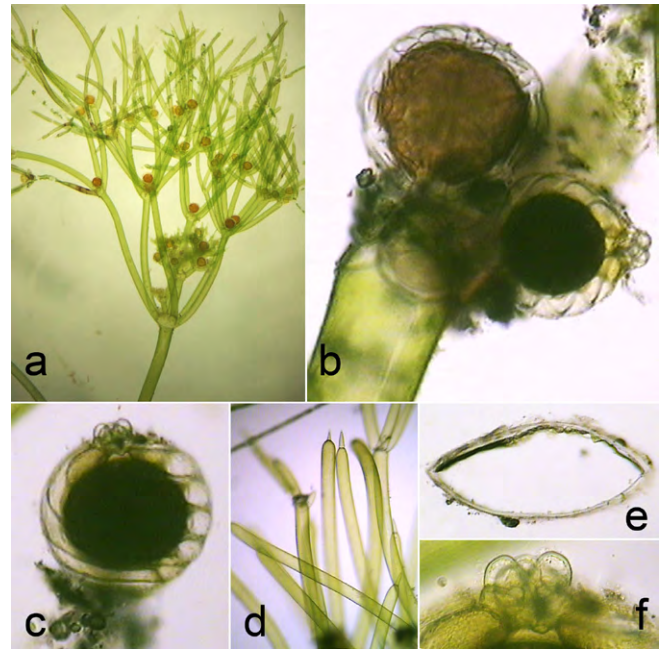

Fig. 8. *Nitella mucronata* in Banias Stream tributary (Site 1; NS): a – upper part of thallus; b – conjoined gametangia ; c – oogonium; d – dactyls; e – cross-section of stem; f – oogonium coronula.

Barinova 2012), but subsequent sampling efforts yielded no results.

In the collection stored in TELA and investigated in our study, there were only 26 sheets of *Nitella* (see above) among 638 sheets of charophytes collected in Israel from ~100 localities, mostly by Y. Lipkin during 1924-1992. We surveyed 905 localities in Israel, including 160 with charophytes, but only three localities of two *Nitella* species were found. It can be concluded that *Nitella* species are very rare in Israel, or at least have been rare since the 1960's.

The rare occurrence of *Nitella* species, which are well known mainly as calcifuges preferring soft waters (Doege *et al.* 2016), is closely related with the presence of outcrops of the carbonate rocks that are widely distributed in the region of study.

Currently four species of *Nitella* are known from Israel. Specimens of *N. oligospira* from Northern Israel are not available, but they may be stored in BM (the British Museum of Natural History) (Washbourn & Jones 1937; Jo Wilbraham, pers. communication). This species was recorded in the USA, Brazil, Venezuela, Pakistan, India, Vietnam and New Caledonia, with the westernmost localities for Eurasia in Pakistan (Pal *et al.* 1962; Langangen 2016). Its finding in Northern Israel is therefore extraordinary from the species range perspective, and *N. oligospira* should be excluded from the list until its presence is confirmed.

All localities of *Nitella* known from Israel are restricted to the Mediterranean region. *Nitella hyalina* and *N. mucronata* are still present in the studied territory, while *N. opaca* is possibly extinct. They appear to be the most common representatives of the genus *Nitella*, yet these are charophyte species very rare for Western Asia (Table 2). *Nitella hyalina* and *N. opaca* are cosmopolitan, while *N. mucronata* is a subcosmopolitan species unknown only for Australia (Mouronval *et al.* 2015). It is one of the most pollution-tolerant charophyte species in Central Europe (Doege *et al.* 2016). *Nitella opaca* could be a vernal or winter species in Israel (as elsewhere in Western Asia) due to its sensitivity to rise in water temperature from the optimal 12-15°C to above 20°C, which results in plant decay (Mouronval *et al.* 2015). Our data allow assessing *Nitella* species in Israel according to IUCN criteria (2014). The status "extinct" for *N. opaca* and status "critically endangered" for *N. hyalina* and *N. mucronata* can be suggested. The main threats for *Nitella* in Israel are likely to be pollution and eutrophication, as well as management of water bodies without respect to nature conservation.

To date eight species of *Nitella* are known from Western Asia (Table 2). However, specimens of *Nitella hyalina*, *N. mucronata* and *N. opaca* were only described and illustrated from different states. Voucher specimen storage is often unreported. Therefore, in several cases confirmation is necessary for different regions, but it is quite problematic without new sampling. The species richness in different states of Western Asia is rather low in comparison with the well-studied states of the Mediterranean region. According to the nomenclature of Krause (1997), 10 species of *Nitella* are known from the Balkans (Blaženčić *et al.* 2006), nine from Italy (Bazzichelli & Abdelahad 2009), 12 from the Iberian Peninsula (Cirujano *et al.* 2008), 11 from Mediterranean Northwest Africa (Corillion 1978; Zouaïdia *et al.* 2015) and 10 from Mediterranean France (Mouronval *et al.* 2015). No *Nitella* species were found during recent intensive studies of charophytes on eastern Greek islands, with the exception of Crete, where *N. hyalina* and *N. tenuisssima* were found in a single lake only (Langangen 2004, 2007, 2008, 2010a, 2010b, 2012, 2013, 2014).

The same situation, i.e., a low number of *Nitella* species, can be inferred from the available data for different states of Central Asia, where it ranges between one and five

Table 2. Species of *Nitella* from states of Western Asia and Egypt.

Species	Israel	Egypt	Turkey	Georgia	Iran	Iraq	Saudi Arabia	Oman
Nitella capillaris (Krocker) Gr. et Bull.-Webst.	-	-	-	+	-	-	-	-
N. confervacea (Brébisson) A. Braun ex Leonhardi	-	-	-	-	-	+	-	-
N. gracilis (Sm.) C. Agardh	-	-	+	-	-	-	-	-
N. hyalina (DC. in Lam. et DC.) C. Agardh	+	+	-	-	+	+	-	-
N. hyalina f. *brachyactis* (A. Braun) Feldm.	-	+	-	-	-	-	-	-
N. mucronata (A. Braun) Miq. in H.C. Hall emend. Wallman	+	+	+	-	-	-	-	+
N. mucronata f. *heteromorpha* A. Braun	+	-	-	-	-	-	-	-
N. mucronata var. *virgata* (Wallman) A. Braun	-	-	+	-	-	-	-	-
N. oligospira A. Braun	+	-	-	-	-	-	-	-
N. opaca (Bruzelius) C. Agardh	+	-	+	+	-	+	-	-
N. opaca f. *heteromorpha* Mig.	-	-	+	-	-	-	-	-
N. tenuissima (Desv.) Kütz.	-	-	-	-	-	+	-	-
Nitella sp.	-	-	-	-	-	-	+	-
Number of species	4	2	3	2	1	4	1	1

[a] A comprehensive bibliography is impossible to report within the scope of this article, so the cited references are those that include all known species from the territory. No published records of *Nitella* have been found for other states of Western Asia and Sinai, Egypt, but they might exist in inaccessible local papers. References: Israel: Jones 1940; Rayss 1951; this study. Egypt: Corillion & Guerlesquen 1971; Corillion 1978; Krause 1997. Turkey: for all available references for *Nitella,* see Barinova *et al.* 2014; LE, checked by R. Romanov. Georgia: Nahucrishvili 1986. Iran: Ahmadi *et al.* 2012. Iraq: Islam 1987; Blaženčić & Temniskova-Topalova 1991; Maulood *et al.* 2013. Saudi Arabia: Khoja & Hussain 1990. Oman: Hussain *et al.* 2003.

species (Romanov *et al.* 2014; Romanov & Boboev 2016). It is very challenging to explain the presence or absence of particular species of *Nitella* in Israel and Western Asia based on their environmental requirements and frequency of occurrence, which are indicated mostly for specimens from European and West Mediterranean African localities, given the significant diversity of ecoregions in Western Asia. However, several reasons for the apparently low species diversity of *Nitella* in this region seem possible. The number of suitable habitats may be low due to a combination of natural factors. Their sensitivity to water pollution and eutrophication, which have been affecting water bodies in this region for a long time, could significantly reduce the number of suitable habitats and thereby explain the rare occurrence of *Nitella* species. Secondly, their possible preference for temporary and semi-temporary water bodies in this region, which are quite variable in appearance and duration of existence from year to year, combined with the lack of regular surveys of all habitats suitable for charophytes, could also lead to conclusions as to their rare occurrence.

Available data (excluding the unconfirmed record of *N. oligospira*) suggest that the species composition of *Nitella* in Western Asia does not include tropical species or distinctive species from Mediterranean Europe and North Africa. This assertion is in obvious contradiction with the presence of *Chara* species with tropical affinity, e.g., *C. benthamii* A. Braun, *C. fibrosa* C. Agardh ex Bruzelius and *C. zeylanica* Willd., in the region, although they are very rare or absent throughout most of Western Asia, with the possible exceptions of Saudi Arabia and Oman (Khoja & Hussain 1990; Hussain *et al.* 2003).

CONCLUSIONS

Information about the species richness, distribution and ecology of *Nitella* in Israel has been updated as a result of consideration of all available specimens, published records and the authors' own field studies. Four species, including two that are new, are known from the region studied, but one of them, *N. oligospira*, should be excluded from the list as an uncheckable doubtful record until it is confirmed. The region studied and Western Asia has no distinctive species, in contrast to the species composition of *Nitella* in Southern Europe and North Africa. It can be concluded that the low species richness and rare occurrence of *Nitella* species in Israel is possibly a common feature for Western and Central Asia.

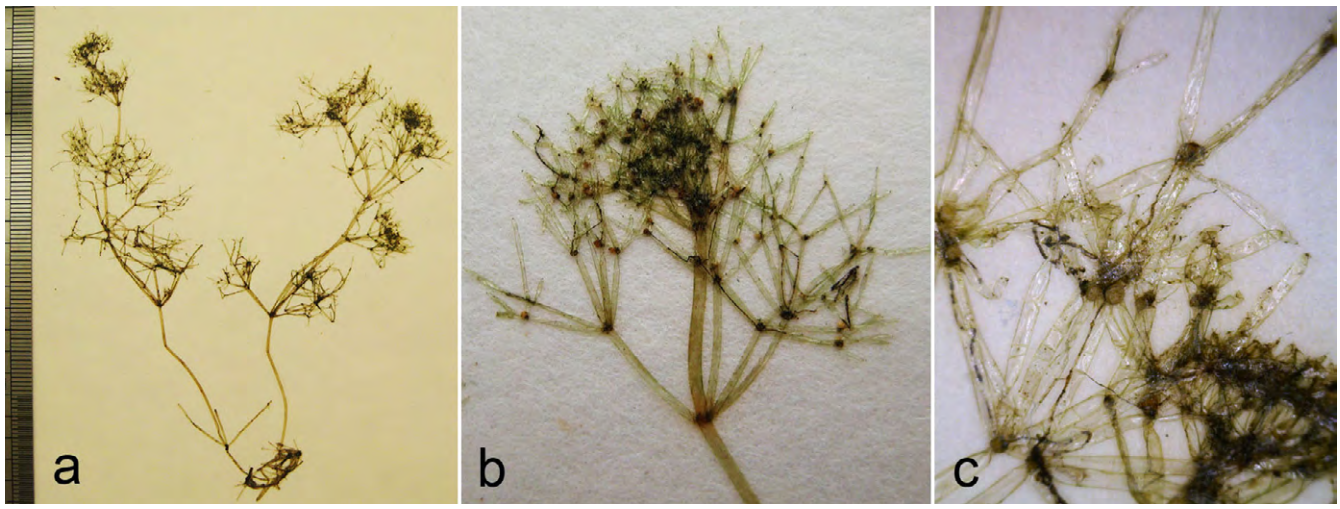

Fig. 9. *Nitella mucronata* in seasonal lake in the Brechat Ya'ar Natural Reserve (Site 4: TELA): a – overall view of thallus; b – upper part of thallus; c – branchlets.

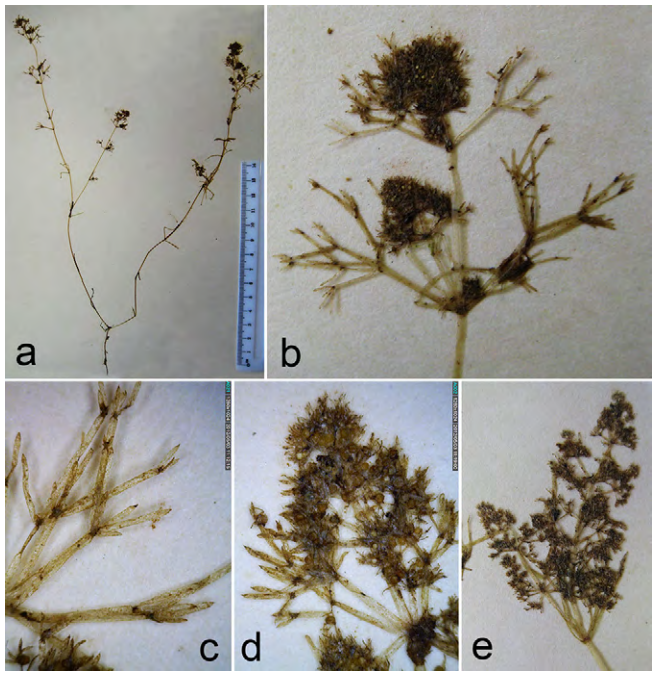

Fig. 10. *Nitella mucronata* f. *heteromorpha* in the Dora pool near Netania (Site 6, TELA): a – overall view of thallus; b, d, e – upper part of thalli; c – branchlets.

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Botanica SERBICA

REZIME

Vrste roda *Nitella* (Charophyceae, Charales) iz Izraela: malo bogatstvo vrsta i retka pojava

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U cilju ažuriranja podataka o distribuciji i ekologiji vrsta roda *Nitella* u Izraelu revidirani su svi raspoloživi primerci, publikovani podaci, kao i podaci autora sa sopstvenih terenskih istraživanja. Istraživanja primeraka iz TELA i novih kolekcija su potvrdila prisustvo *N. mucronata* i otkrila dve nove vrste za istraživano područje - *N. hyalina* i *N. opaca*. Raniji podaci o prisustvu *N.oligospora* u Izraelu su sumnjivi s aspekta areala vrste. Prikazana je ekologija vrsta *N. hyalina* i *N. mucronata* u Izraelu. Nema razlika u sastavu vrsta roda *Nitella* u Izraelu i umerenoj i subtropskoj zoni Evroazije, osim da je prva varijanta znatno osiromašenija od poslednje dve. Na osnovu dostupnih podataka, izgleda da su malo bogastvo vrsta i retko pojavljivanje zajednička karakteristika *Nitella* iz svih ostalih zemalja zapadne i centralne Azije.

Ključne reči: harofite, vrsta bogatstvo, ekologija, zaštita vrsta, istočni Mediteran