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## SUMMARY

One topic common to all biogeographic research is change over space and through time. Ecologists, studying the relationships between organisms and their environment, are concerned with spatial change. Historical biogeography deals with relationships between the earth's history and the distribution of organisms, thus, with change through time. In the present state of knowledge it is difficult to come to integrated hypotheses concerning the historical causes of seaweed distribution patterns. An important reason for this is the lack of information on relationships between geographically distant seaweed populations and seaweed species.

A lack of sufficient information on relationships is certainly true for the green algae genus *Cladophora*. A number of species of this genus are distributed world-wide, but the history and the factors that caused this distribution are not or poorly known. Furthermore, most *Cladophora* species are notoriously variable with respect to their morphology, a factor that complicates the formulation of unequivocal taxonomical conclusions.

The aim of this thesis was to address the role of historical biogeographic factors on the distribution patterns of some *Cladophora* species, by considering the geographic distribution of inter- and intraspecific DNA divergence. The primary strength of this method is that it yields data directly in the form of distances which in turn can be used in biogeographic analyses.

The resemblance, at least with regard to the amount of repeated DNA sequences, between the nuclear genomes *Cladophora* species and the genome of an average higher plant is one of the results presented in chapter 2. The chapter further presents data which indicate that the high level of DNA similarity between East and West Atlantic isolates of *C. sericea* is the result of trans-Atlantic dispersal which presumably took place after the last glaciation.

*C. albida* is distributed in the warm to warm temperate climatic belts of the northern and southern hemispheres. North Atlantic and Indo-West Pacific isolates of this species differed to such a degree when analyzed for their DNA that they can be classified as morphologically indistinguishable, but different species. The correlation between the observed DNA divergence and the present distribution of the isolates tested raised the suggestion that *C. albida* had been divided into a North Atlantic and an Indo-West Pacific group as a consequence of an allopatric subdivision. It is assumed in chapter 3 that this subdivision could have been initiated by the Miocene closure of the Asian part of the Tethys ocean. Support for this vicariant mode of speciation came from DNA hybridizations between species of the *C. pellucida* group (chapter 4). This subgroup in the genus *Cladophora* is comprised of stenothermous species with relatively restricted distribution areas. DNA hybridizations between North Atlantic and Australian



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bers of nucleotide substitutions in sequences that code for a specific function increase at reduced DNA homology levels. This means that DNA evolution as indicated by DNA hybridizations is not linear, but curvilinear related to evolutionary time elapsed. In other words the greater the time of separation between organisms the slower the rate of DNA evolution appears to be.

The discussion in chapter 9 tries to explain the general trend in the North Atlantic of an increasing number of East and West Atlantic endemics as one approaches the tropics. Analyses of DNA hybridizations between amphi-Atlantic *Cladophora* isolates suggest that, at least for the species tested, the North Atlantic ocean does not act as an absolute dispersal barrier, but that present and historical ecological factors at the end points of this barrier (the Atlantic coasts) were and, probably are, decisive in this respect.

In de meeste gevallen is de bestudering van fossielen de enige manier om bovenstaande processen waar te nemen en daar mee biogeografische hypothesen te toetsen. Deze werkwijze is in het geval van zeewier biogeografie echter niet mogelijk omdat er, op een enkele uitzondering na, geen fossielen beschikbaar zijn. Fossiele betekent dit dat voor de toetsing van biogeografische hypothesen van zeewieren alleen de huidige zeewiersoorten en de daaruit samengestelde flora's gebruikt kunnen worden. Maar ook met behulp van de thans levende zeewierflora is het mogelijk hypothesen te toetsen. Zo is gebleken dat de verspreidingsgrens van een zeewiersoort voornamelijk wordt bepaald door de temperatuur van het zeewater. Bovendien is het mogelijk historische hypothesen te toetsen door gebruik te maken van de veranderingen die in de loop der tijd zijn gecumuleerd in het DNA.

In dit proefschrift wordt ingegaan op de mogelijkheden van het laatste thema, dus op de vraag of de historische factoren die een rol hebben gespeeld bij de totstandkoming van verspreidings patronen van zeewierflora's terug te vinden in het DNA van thans levende soorten.

Het onderzoek heeft zich gericht op enkele soorten uit het geslacht *Cladophora*. Dit groenwier geslacht wordt gekarakteriseerd door een vertakte draadvormige structuur van multinaclaire cellen. Sommige soorten zijn nagenoeg wereldwijd verspreid, terwijl de verspreiding van andere soorten is beperkt tot een klein gebied, of over kortere of langere afstanden is onderbroken. Het geslacht *Cladophora* is om een aantal redenen als studie object gekozen: (1) De distributie en de taxonomie van *Cladophora* soorten waren, althans bij de aanvang van het onderzoek, redelijk goed bekend; (2) In een parallel lopend onderzoek werden de temperatuur af-