中华人民共和国人与生物圈国家委员会成立四十周年大会

青藏高原植物多样性研究：回顾与展望

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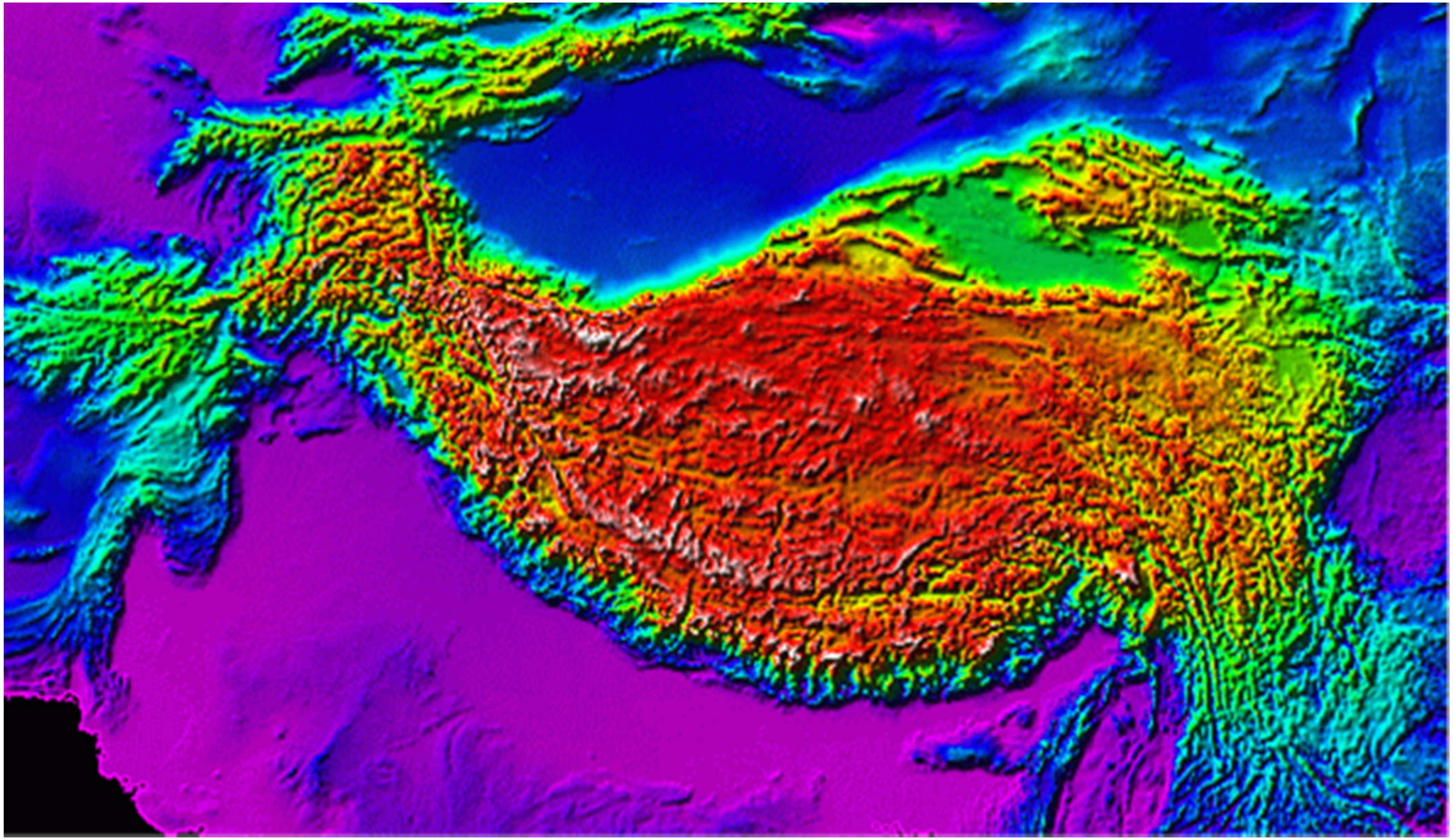
2018.07.31 北京



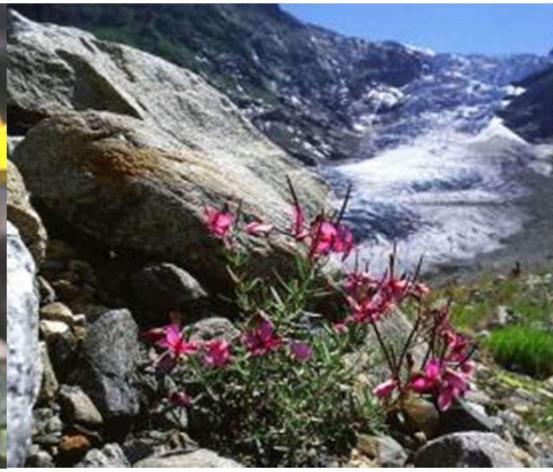
我国境内部分西起帕米尔高原, 东至横断山脉, 横跨31个经度, 东西长约 2945 km ;南自喜马拉雅山脉南缘, 北迄昆仑山-祁连山北侧, 纵贯约13 个纬度, 南北宽达1532 km , 范围为 26°00′12″N-39°46′50″N, 73°18′52″E-104°46′59″E, 面积250多万 km2 , 占我国陆地总面积的 26.8 %

张镱锂 **et al. 2002** 地理研究

报告提纲

- 第一次青藏科考的丰硕成果
- 半个世纪来对高原植物的认识
- 青藏高原植物研究的展望






1.1 外国人对青藏高原植物的考察



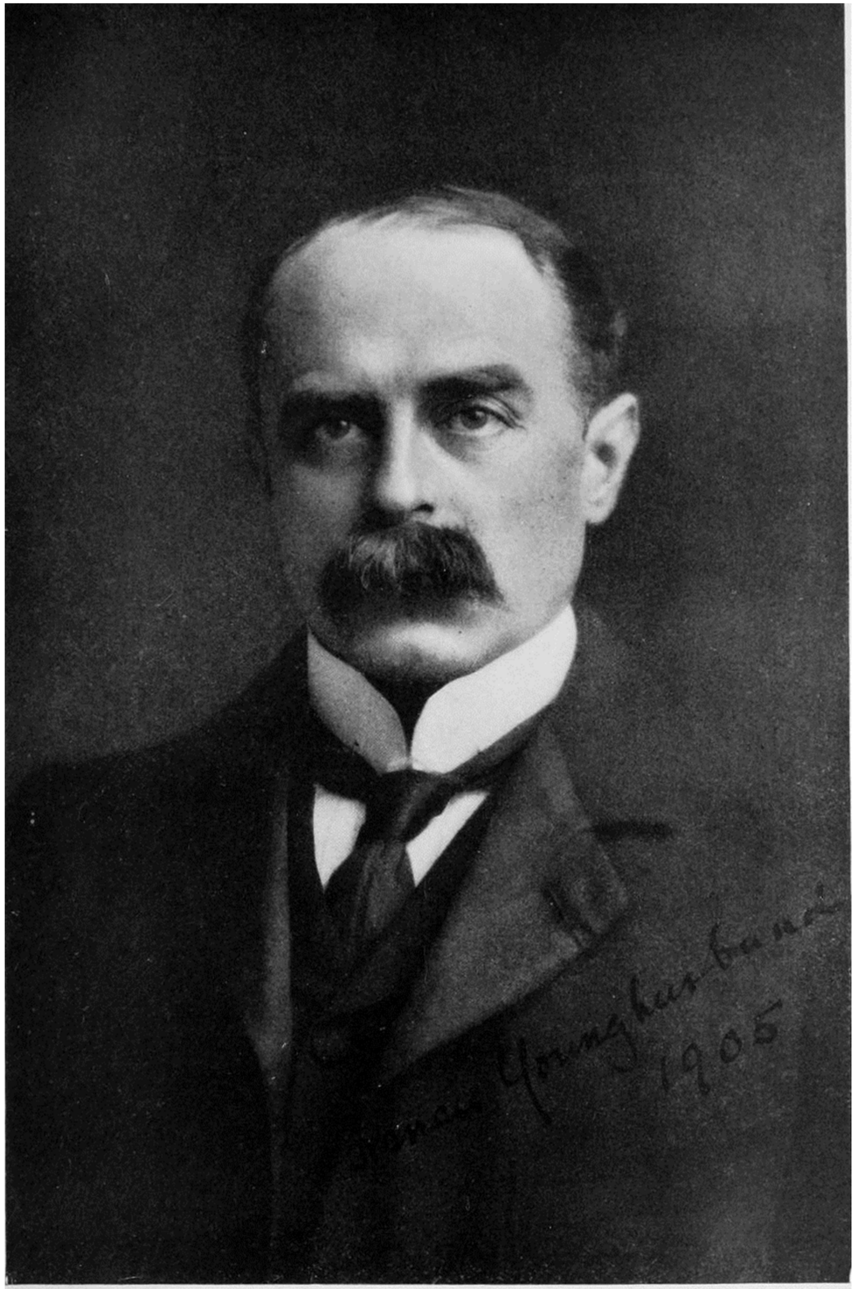
马尿泡（茄科）*Przewalskia tangutica* Maxim.

Nikolay Mikhaylovich Przhevalsky

俄国军官,曾经在新疆、青海（黄河源）等地考察，采集动植物标本。我国许多动植物学名均以名字命名，如普氏野马，星叶草属（*Circaeaster* Maxim.）

藏波罗花（紫薇科）*Incarvillea younghusbandii* Sprague

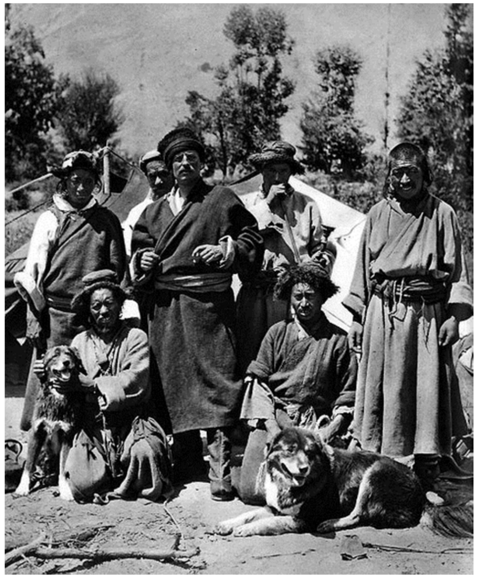
英国军官、作家、探险家。在远东和中亚地区考察，1904年领导英国入侵西藏，历任英国驻新疆、西藏特派员，皇家地理学会主席。



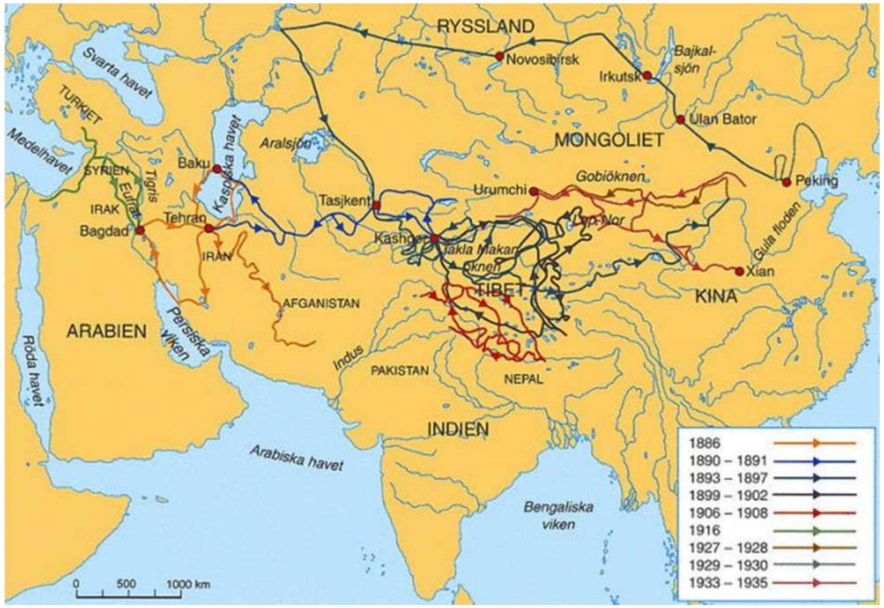
[Photo by Lewis, Clifton

SIR FRANCIS YOUNGHUSBAND, K.C.I.E.

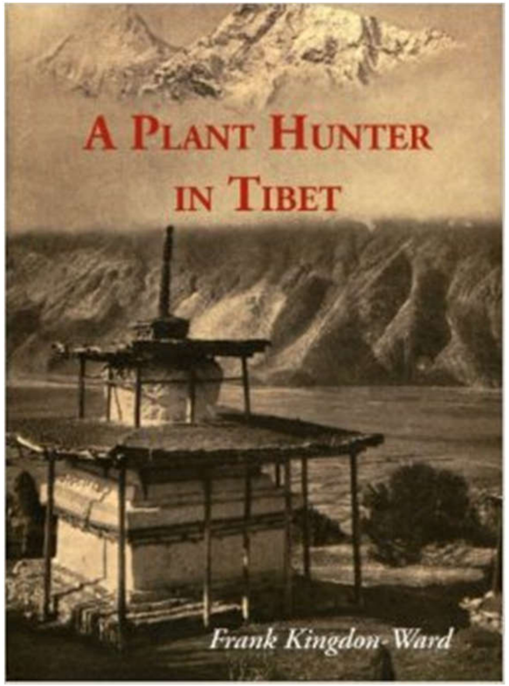
藏荠属（十字花科）*Hedinia* Ostenf.

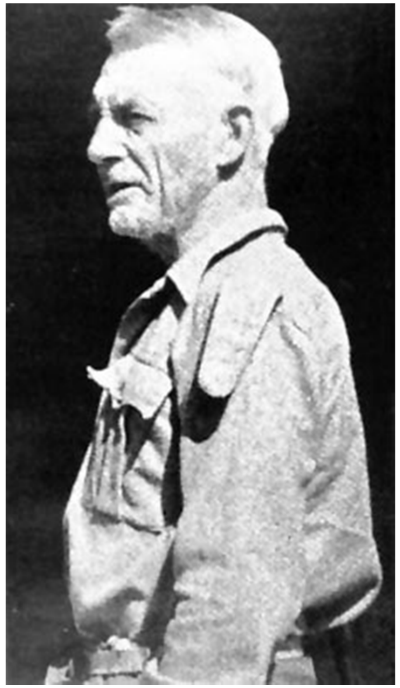


Sven Anders Hedin



瑞典著名地理学家、探险家，多次在新疆罗布泊、塔克拉玛干和藏北以及西藏西部考察。

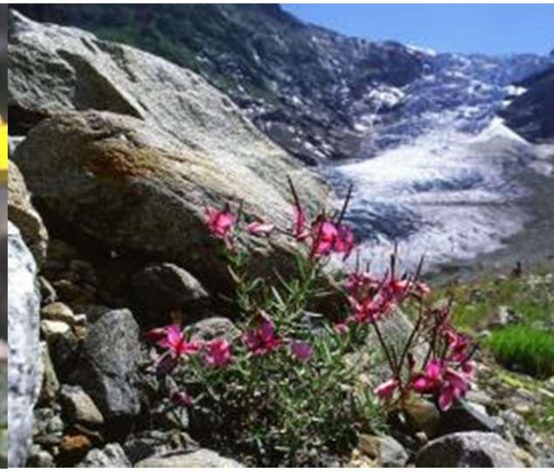




独叶草（毛茛科）*Kingdonia uniflora* Balf. f. et W. W. Smith

Francis (Frank) Kingdon-Ward，英国植物学家和探险家，他致力于采集云南西北部、喜马拉雅以东地区的山地植物。曾经在云南北部、西藏东部以及缅甸北部进行了多次探险考察，出版了24本书。






1.2 第一次青藏科考的植物多样性研究成果



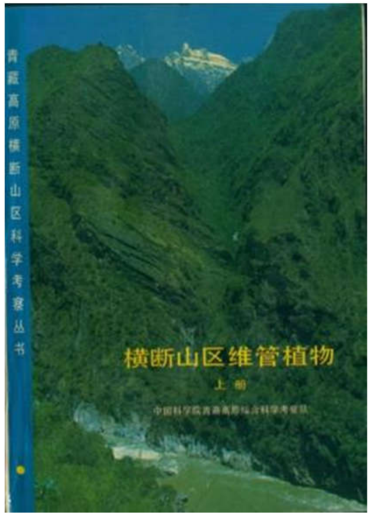
刘慎谔：1931-1946年前往新疆、西藏北部-克什米尔-印度北采集标本2500号；可惜这些标本在从印度运中国途中失落。

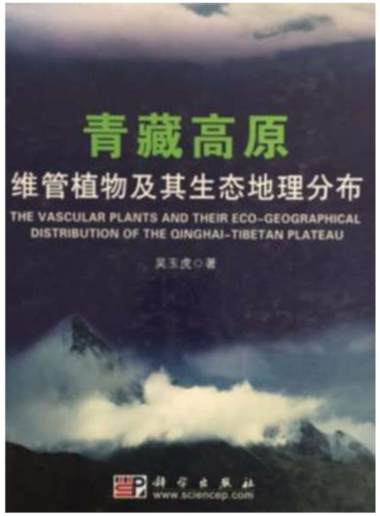
俞德浚：1932-1938年在云南、四川和西藏东南部采集标本达200,000 余份。

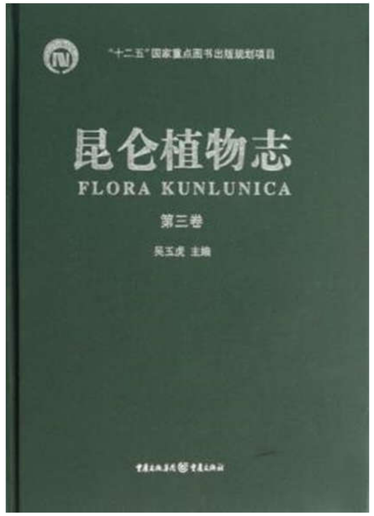
钟补求：解放后1950随解放大军入藏，为我国在西藏系统采集植物标本第一人。

- **1960年武素功等：西藏察瓦龙，300余号标本**
- **1960-1961年傅国勋等：波密、错那、亚东等地，2000余号标本**
- **1963年杨金祥等：安多、那曲，800余号标本**
- **1965-1966年张承田等：波密、拉萨、聂拉木等，4472号标本**
- **1966年应俊生等，藏东南地区，2190号标本**
- **1968年郎楷永等，珠峰等地，450号标本**
- **1972年王金亭等，拉萨地区及日喀则地区各县，3500余号标本**

1973年-1976年几乎到了西藏的主要地区，植物组采集标本15000余号，植被组采集14000余号，林业组采集4500余号，草场组采得标本2000余号。







- 《西藏植物志》记载西藏高等植物208科1258属5766种，共5卷。
- 《青海植物志》记载青海高等植物114科632属2418种，共4卷。
- 《横断山维管植物》记录维管植物219科，1467属，8559种。
- 《青藏高原维管植物》记录维管植物222科，1543属，9556种。
- 《昆仑植物志》记载87科、555属、2431种。

青藏高原植物区系特点

- 青藏高原特别是东南部的植物区系是相当丰富的，绝不如过去一般想象和某些文献记录中那样贫乏。
- 特有属少，特有种多，表明青藏高原的种子植物区系隶属于北温带、衍生的和年青的性质。
- 藏东南和东喜马拉雅有一定的避难所，总体看青藏高原是古地中海植物和中国-喜马拉雅植物成分的活化地，高山、高原寒化和旱化环境对促进了物种的形成。

Wu Zheng-Yi et al. 1981, Dissertation upon the Origin, Development and Religonalization of Xizang Flora through the Floristic Analysis. Proc Sym Qinghai-Xizang Plateau (Beijing, China) Science Press: Beijing. Vol. 2:1219 – 1244.

报告提纲

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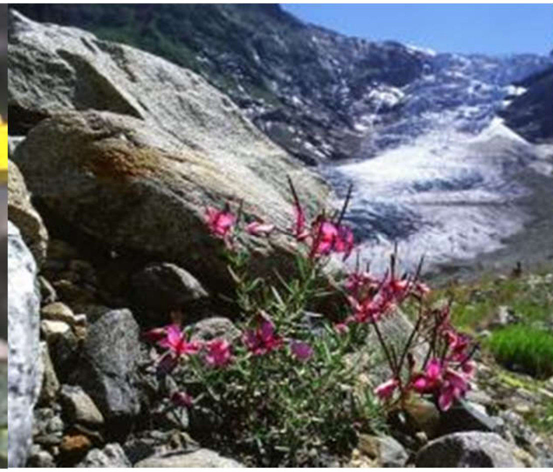
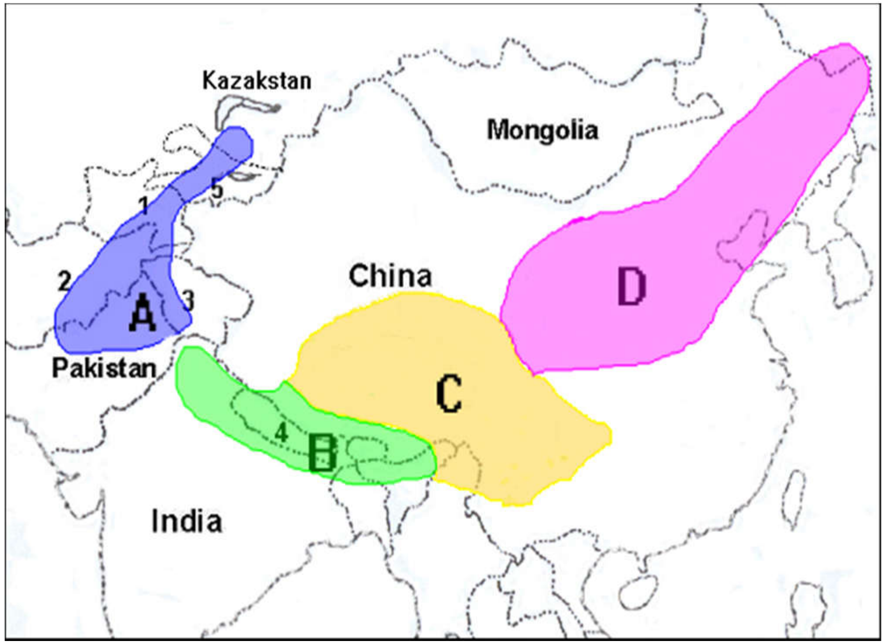
- 青藏高原植物研究的展望

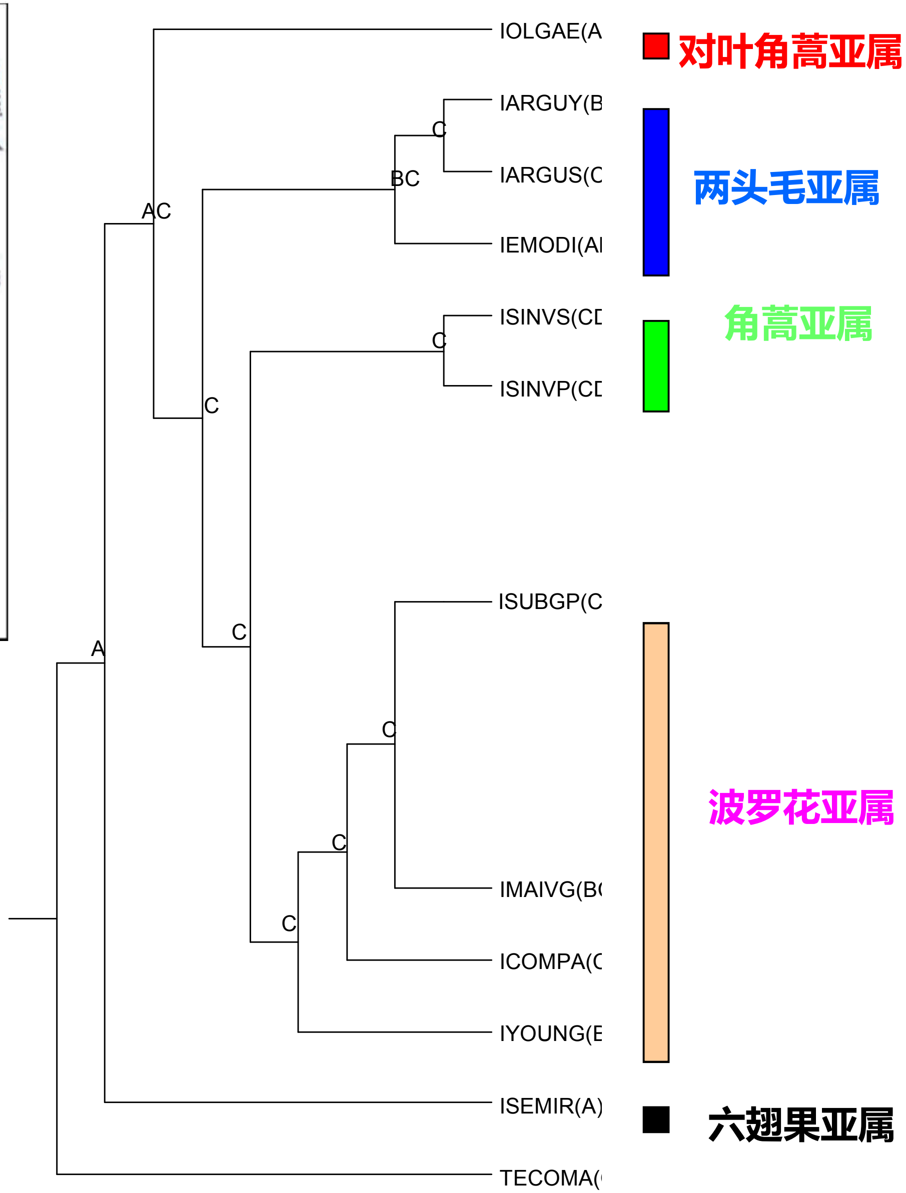


2.1 青藏高原植物多样性的起源

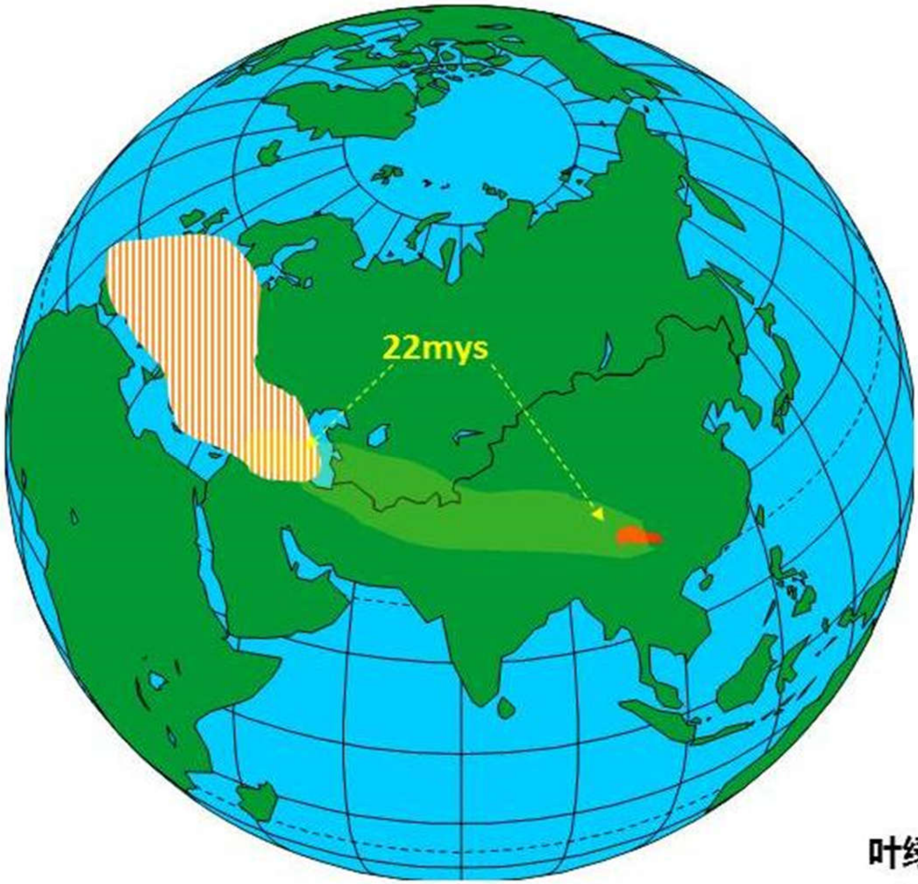
角蒿属(*Incarvillea*)的起源与进化



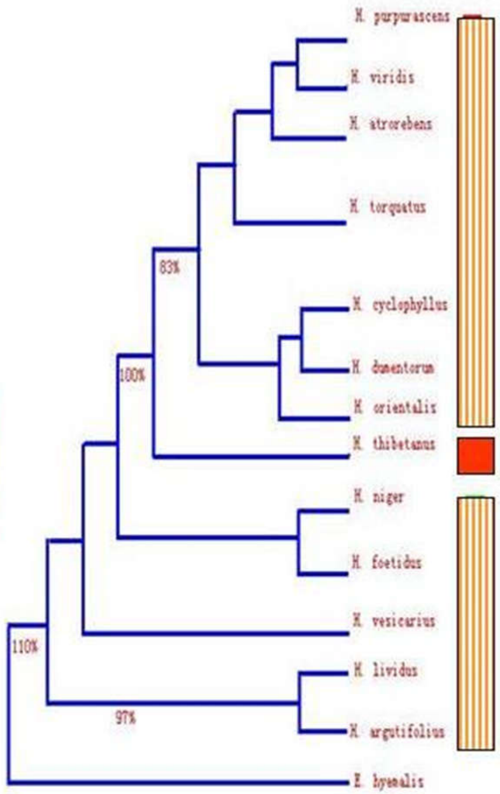
ITS+TrnL-F分析结果表明，基部的2个单型亚属分布于中亚，最进化和分化最剧烈的类群集中分布于喜马拉雅和横断山地区。**该属最早的发生是在中亚（也即古地中海地区），起源时间应该是在中新世，然后向东亚迁移。在青藏高原剧烈隆升时获得了新的发展**(Chen ST et al, 2005)。



铁筷子属(*Helleborus*)现代地理分布格局的形成



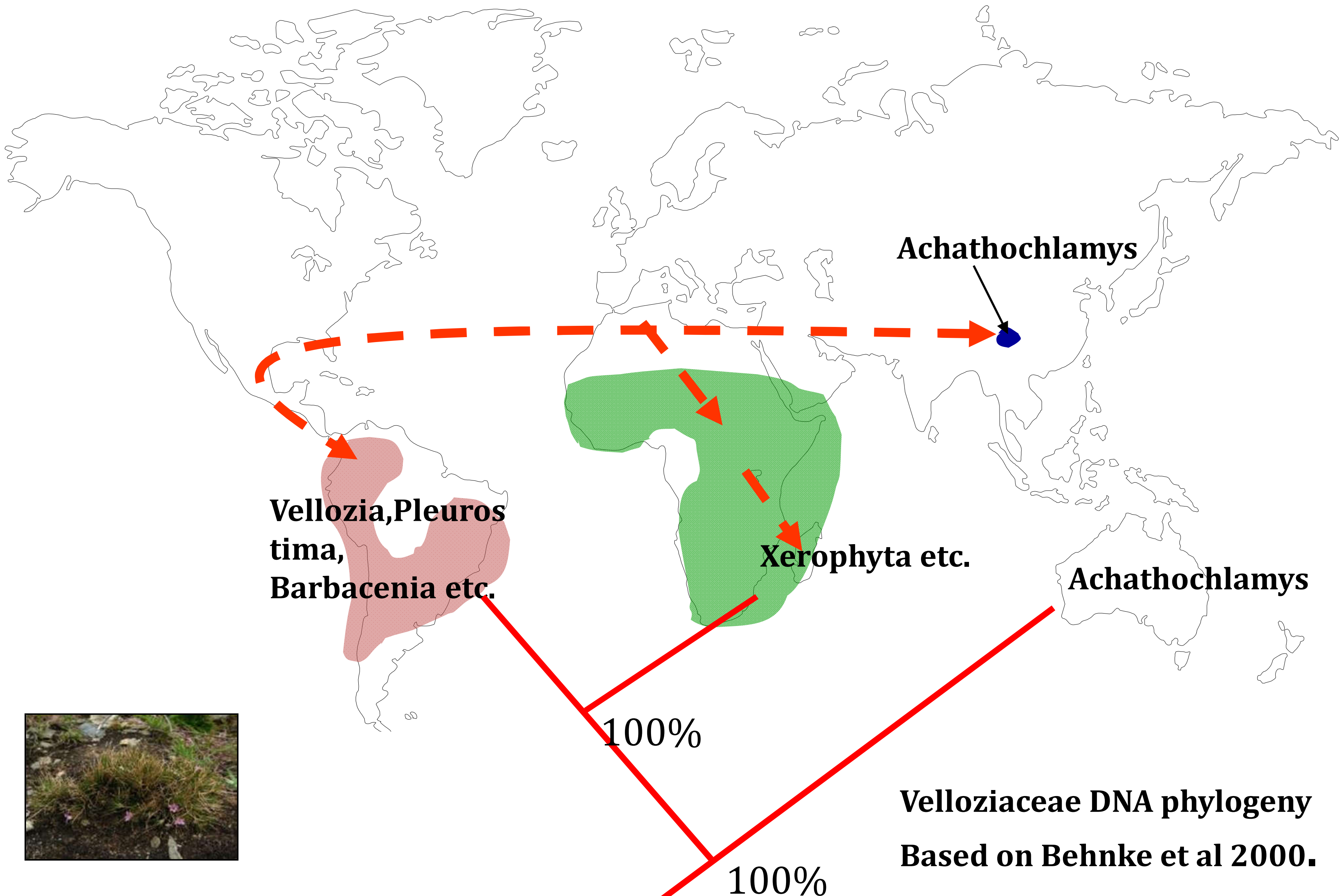
Disjunction of Hellebours



叶绿体DNAmatK,trnL-F和核DNA
ITS序列联合分析的严格一致性树

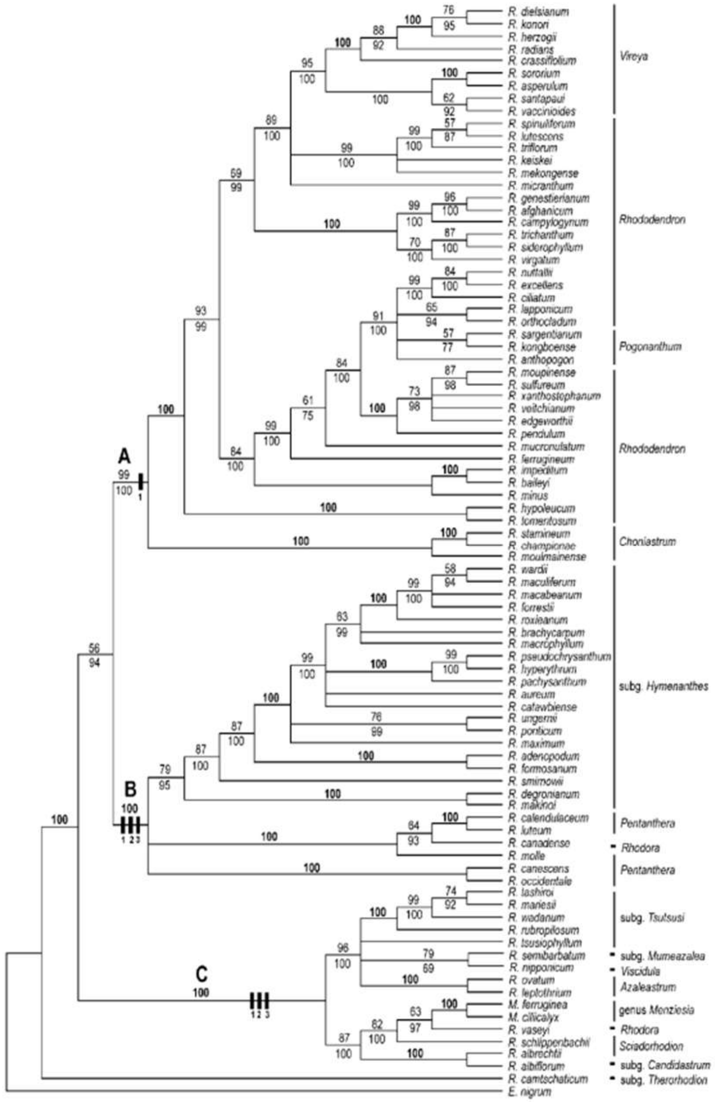
***Helleborus thibetanus*显然是特提斯第三纪的孑遗成员,说明在早第三纪时铁筷子属在古地中海有着连续的分布,其间断的形成是中新世喜马拉雅的隆升古地中海退却的缘故.**

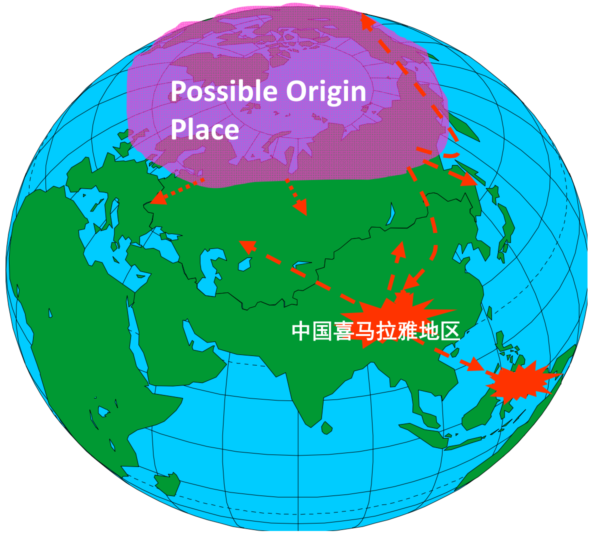
Distribution of *Achathochlamys* and other genera of Velloziaceae



芒苞草(*Achathochlamys*)的起源

杜鹃属(*Rhododendron*)的起源与传播





Rhododendron Origin and possible migration line

Rhododendron Origin and possible migration line

Goetsch L et al, 2005 Syst Bot. 30(3):616-626.

杜鹃属起源在北极地区，在中国喜马拉雅地区形成分化中心，又向全球扩展。

青藏高原植物区系特点

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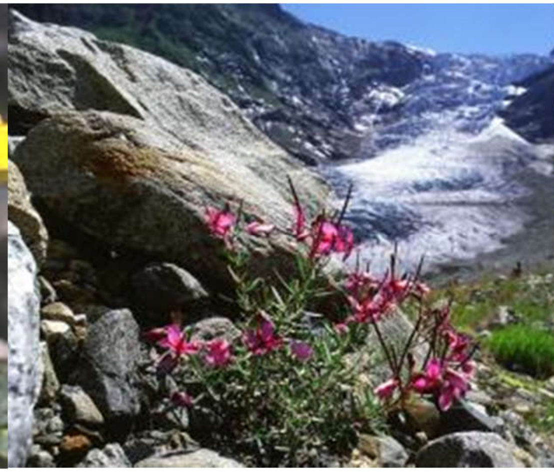
- 特有属少，特有种多，表明青藏高原的种子植物区系隶属于北温带、衍生的和年青的性质。
- 藏东南和东喜马拉雅有一定的避难所，总体看青藏高原是古地中海植物和中国-喜马拉雅植物成分的活化地，高山、高原寒化和旱化环境对促进了物种的形成。

Wu Zheng-Yi et al. 1981, Dissertation upon the Origin, Development and Religonalization of Xizang Flora through the Floristic Analysis. Proc Sym Qinghai-Xizang Plateau (Beijing, China) Science Press: Beijing. Vol. 2:1219 – 1244.

- 古地中海区系和北极—第三纪植物区系是青藏高原现代高山植物区系二大源头。

- 现代高山植物区系的形成是在喜马拉雅隆升及新第三纪以后发展起来的，直到现在还在继续分化的年青区系。

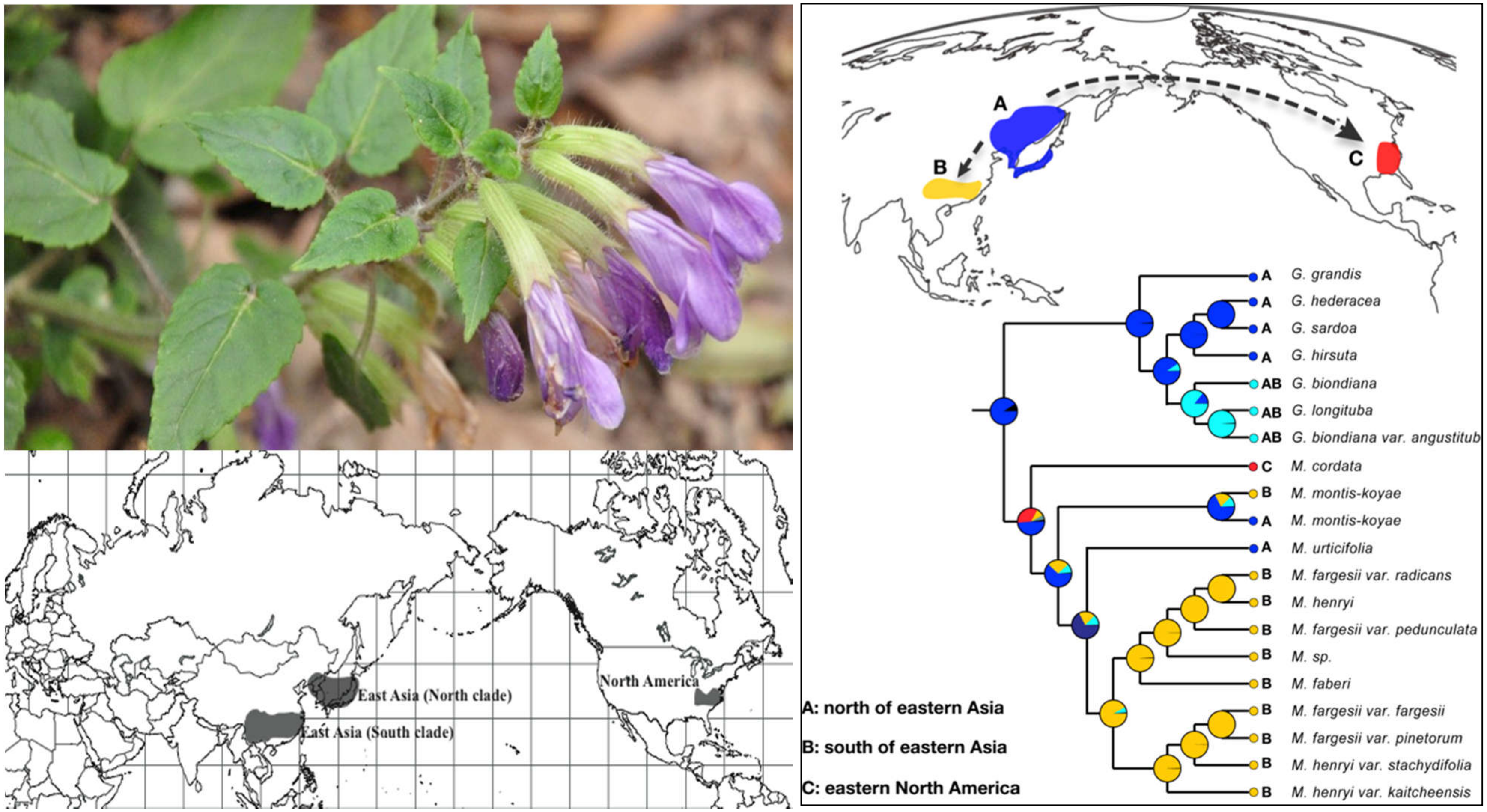





2.2 青藏高原植物多样性的演化与分布格局



龙头草属(*Meehania*) 揭示中国喜马拉雅地区草本植物的北极 - 第三纪起源



Deng, T. et al., 2015**.** ***PloS One*** 10(2): e0117171. Doi: 10.1371/journal.pone.0117171**.**

沙棘(*Hippophae rhamnoides*)从中国喜马拉雅地区起源后向欧洲和周边散布

New Phytologist

Research

Out of the Qinghai–Tibet Plateau: evidence for the origin and dispersal of Eurasian temperate plants from a phylogeographic study of *Hippophaë rhamnoides* (Elaeagnaceae)

Dong-Rui Jia[1,2,3], Richard J. Abbott[4], Teng-Liang Liu[1], Kang-Shan Mao[1], Igor V. Bartish[2] and Jian-Quan Liu[1]

[1]Molecular Ecology Group, State Key Laboratory of Grassland Agro-Ecosystem, School of Life Science, Lanzhou University, Lanzhou 730000, Gansu, China; [2]Department of Genetic Ecology, Institute of Botany, Academy of Sciences of the Czech Republic, Zamek 1, 252 43 Pruhonice, Czech Republic; [3]Department of Botany, Faculty of Science, Charles University in Prague, Benátská 2, CZ-128 01 Prague, Czech Republic; [4]School of Biology, University of St Andrews, St Andrews, Mitchell Building, Fife KY16 9TH, UK

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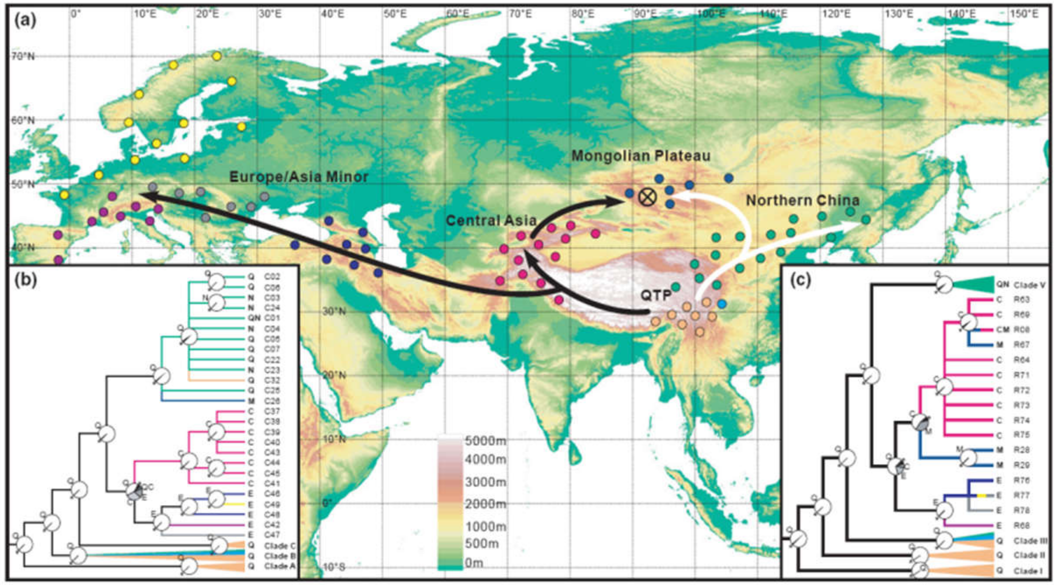
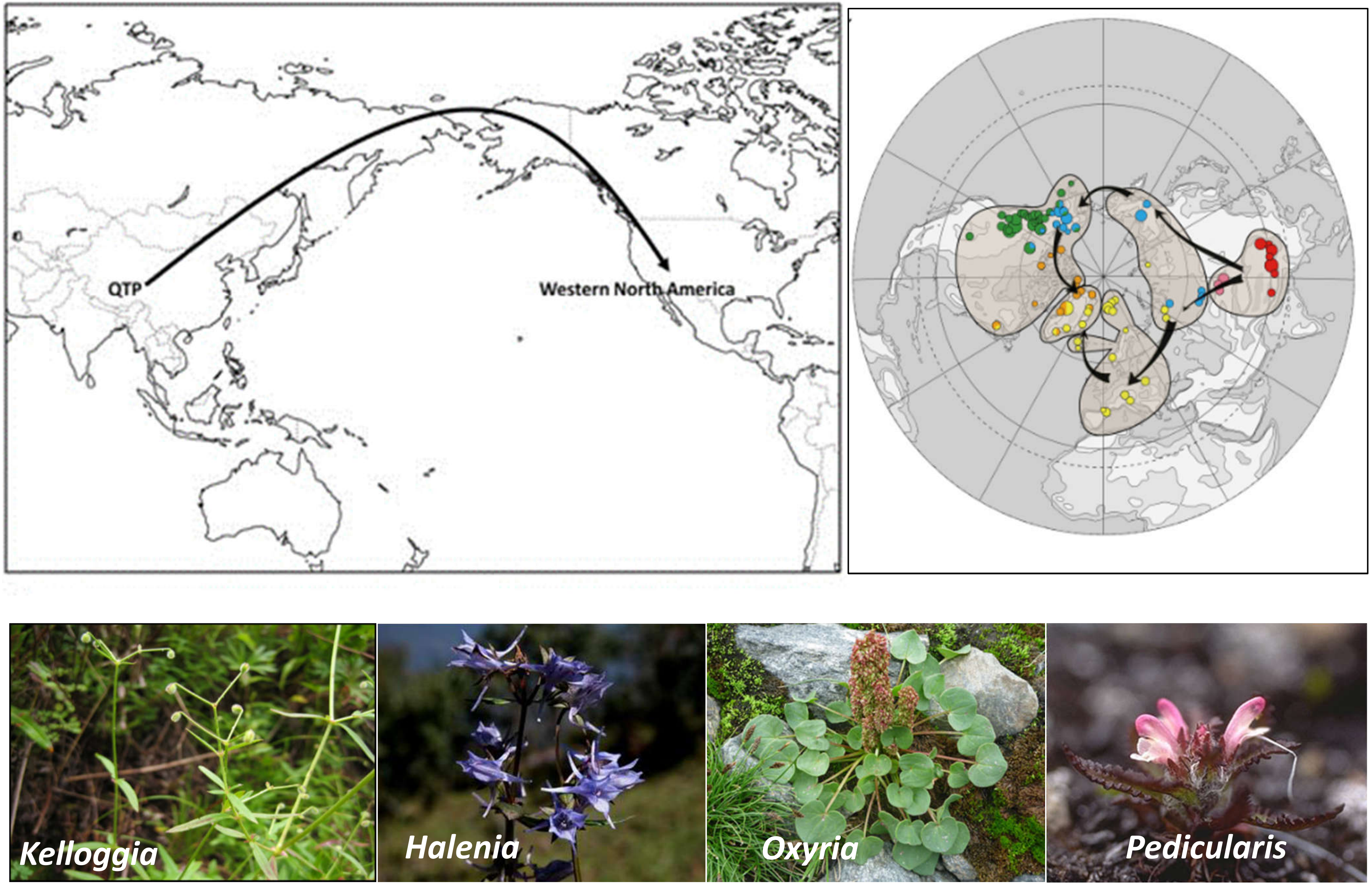
doi: 10.1111/j.1469-8137.2012.04115.x

Summary

- Numerous temperate plants now distributed across Eurasia are hypothesized to have originated and migrated from the Qinghai-Tibet Plateau (QTP) and adjacent regions. However, this hypothesis has never been tested through a phylogeographic analysis of a widely distributed species. Here, we use *Hippophaë rhamnoides* as a model to test this hypothesis.
- We collected 635 individuals from 63 populations of the nine subspecies of *H. rhamnoides*. We sequenced two maternally inherited chloroplast (cp) DNA fragments and also the bi-paternally inherited nuclear ribosomal ITS.
- We recovered five major clades in phylogenetic trees constructed from cpDNA and internal transcribed spacer (ITS) sequence variation. Most sampled individuals of six subspecies that are distributed in northern China, central Asia and Asia Minor/Europe, respectively, comprised

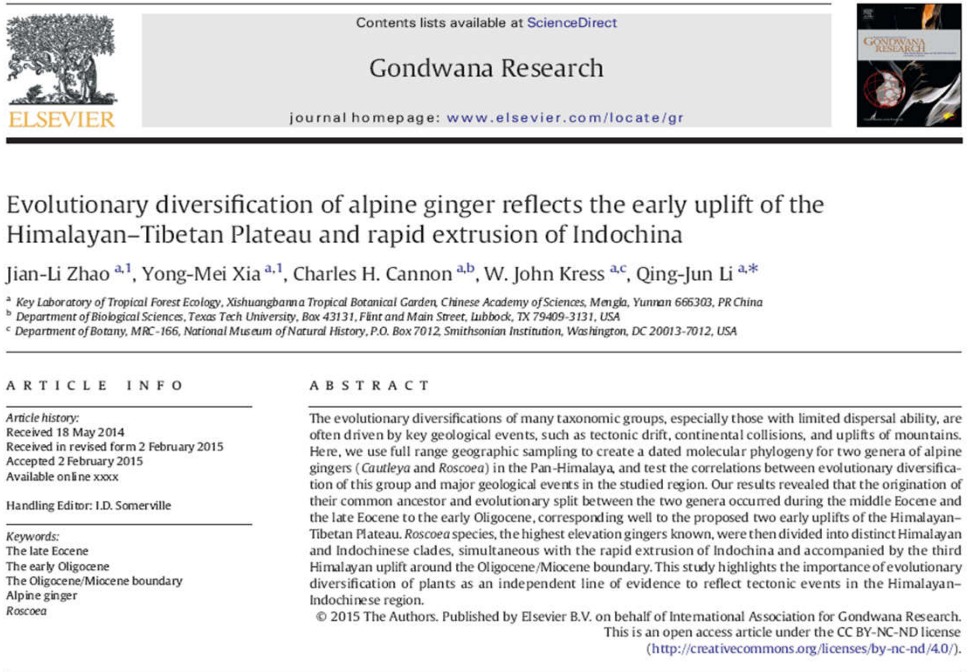



QTP
Western North America
Kelloggia
Halenia
Oxyria
Pedicularis


Greenland
CANADA
UNITED STATES
BRAZIL
RUSSIA
SIBERIA
KAZAKHSTAN
CHINA
INDIA
ALGERIA
LIBYA
EGYPT
SAHARA
CHAD
SUDAN
ANGOLA
AUSTRALIA
INDONESIA
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
INDIAN OCEAN

柳属植物的传播路线

象牙参属(Roscoea)的起源于演化反映了青藏高原地质历史形成的过程



Contents lists available at ScienceDirect

Gondwana Research

journal homepage: www.elsevier.com/locate/gr

Evolutionary diversification of alpine ginger reflects the early uplift of the Himalayan–Tibetan Plateau and rapid extrusion of Indochina

Jian-Li Zhao [a,1], Yong-Mei Xia [a,1], Charles H. Cannon [a,b], W. John Kress [a,c], Qing-Jun Li [a,*]

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[b] Department of Biological Sciences, Texas Tech University, Box 43131, Flint and Main Street, Lubbock, TX 79409-3131, USA
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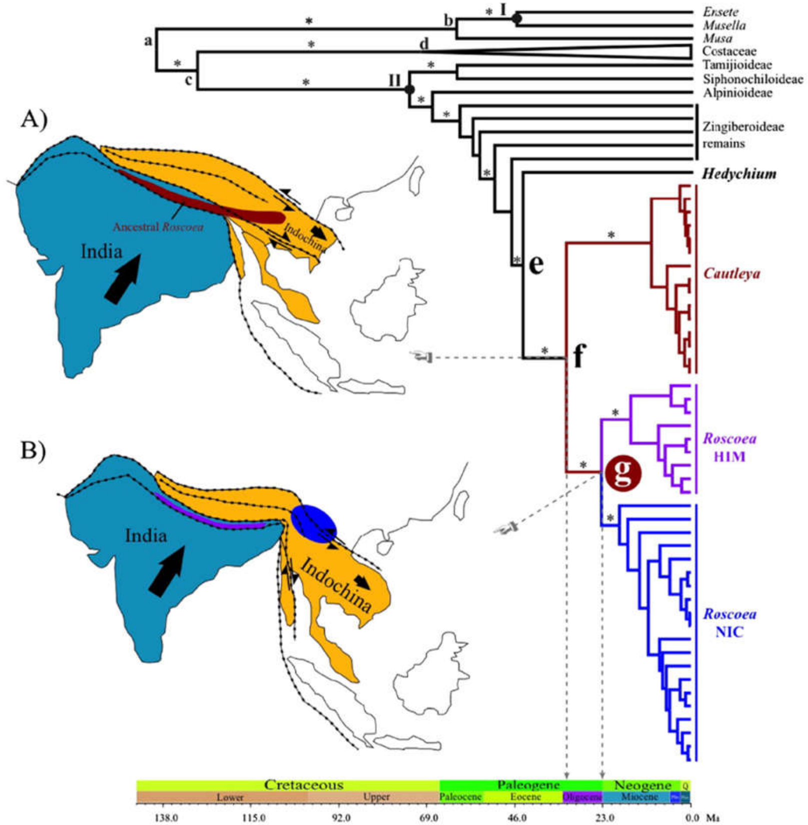
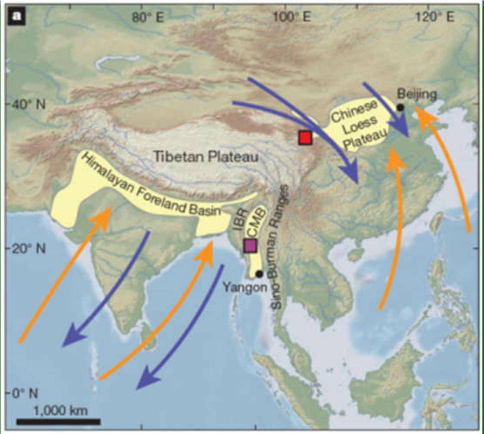
Alpine ginger
Roscoea

ABSTRACT

The evolutionary diversifications of many taxonomic groups, especially those with limited dispersal ability, are often driven by key geological events, such as tectonic drift, continental collisions, and uplifts of mountains. Here, we use full range geographic sampling to create a dated molecular phylogeny for two genera of alpine gingers (*Cautleya* and *Roscoea*) in the Pan-Himalaya, and test the correlations between evolutionary diversification of this group and major geological events in the studied region. Our results revealed that the origination of their common ancestor and evolutionary split between the two genera occurred during the middle Eocene and the late Eocene to the early Oligocene, corresponding well to the proposed two early uplifts of the Himalayan–Tibetan Plateau. *Roscoea* species, the highest elevation gingers known, were then divided into distinct Himalayan and Indochinese clades, simultaneous with the rapid extrusion of Indochina and accompanied by the third Himalayan uplift around the Oligocene/Miocene boundary. This study highlights the importance of evolutionary diversification of plants as an independent line of evidence to reflect tectonic events in the Himalayan–Indochinese region.





ARTICLE

doi:10.1038/nature13704

Asian monsoons in a late Eocene greenhouse world

A. Licht[1,2,3], M. van Cappelle[4,5], H. A. Abels[4,6], J.-B. Ladant[7], J. Trabucho-Alexandre[8], C. France-Lanord[2], Y. Donnadieu[7], J. Vandenberghe[9], T. Rigaudier[2], C. Lécuyer[10], D. Terry Jr[11], R. Adriaens[6], A. Boura[12], Z. Guo[13], Aung Naing Soe[14], J. Quade[3], G. Dupont-Nivet[4,13,15,16] & J.-J. Jaeger[1]

The strong present-day Asian monsoons are thought to have originated between 25 and 22 million years (Myr) ago, driven by Tibetan-Himalayan uplift. However, the existence of older Asian monsoons and their response to enhanced greenhouse conditions such as those in the Eocene period (55–34 Myr ago) are unknown because of the paucity of well-dated records. Here we show late Eocene climate records revealing marked monsoon-like patterns in rainfall and wind south and north of the Tibetan-Himalayan orogen. This is indicated by low oxygen isotope values with strong seasonality in gastropod shells and mammal teeth from Myanmar, and by aeolian dust deposition in northwest China. Our climate simulations support modern-like Eocene monsoonal rainfall and show that a reinforced hydrological cycle responding to enhanced greenhouse conditions counterbalanced the negative effect of lower Tibetan relief on precipitation. These strong monsoons later weakened with the global shift to icehouse conditions 34 Myr ago.

Palaeogeography, Palaeoclimatology, Palaeoecology xxx (2010) xxx–xxx

Contents lists available at ScienceDirect

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Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

PALAEO 3

Quantitative reconstruction of the Late Miocene monsoon climates of southwest China: A case study of the Lincang flora from Yunnan Province

Frédéric M.B. Jacques [a,b], Shuang-Xing Guo [b], Tao Su [a,c], Yao-Wu Xing [a,c], Yong-Jiang Huang [a,c], Yu-Sheng (Christopher) Liu [d], David K. Ferguson [e], Zhe-Kun Zhou [a,f,*]

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[b] Department of Palaeobotany and Palynology, Nanjing Institute of Geology and Palaeontology, the Chinese Academy of Sciences, Nanjing 210008, Jiangsu, PR China
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ABSTRACT

The Miocene Lincang leaf assemblage is used in this paper as proxy data to reconstruct the palaeoclimate of southwestern Yunnan (SW China) and the evolution of monsoon intensity. Three quantitative methods were chosen for this reconstruction, i.e. Leaf Margin Analysis (LMA), Climate Leaf Analysis Multivariate Program (CLAMP), and the Coexistence Approach (CA). These methods, however, yield inconsistent results, particularly for the precipitation, as also shown in European and other East Asian Cenozoic floras. The wide range of the reconstructed climatic parameters includes the Mean Annual Temperature (MAT) of 18.5–24.7 °C and the Mean Annual Precipitation (MAP) of 1213–3711 mm. Compared with the modern Lincang climate (MAT, 17.3 °C; MAP, 1178.7 mm), the Miocene climate is slightly warmer, wetter and has a higher temperature seasonality. A detailed comparison on the palaeoclimatic variables with the coeval Late Miocene Xiaolongtan flora from the eastern part of Yunnan allows us to investigate the development and interactions of both South Asian and East Asian monsoons during the Late Miocene in southwest China, now under strong influence of these monsoon systems. Our results suggest that the monsoon climate has already been established in southwest Yunnan during the Late Miocene. Furthermore, our results support that both Southeast Asian and East Asian monsoons co-occurred in Yunnan during the Late Miocene.

- 亚洲季风的形成对现代中国喜马拉雅植物区系的形成和演变产生了巨大的影响

- 季风气候的形成后，原来的干旱地中海型气候转向湿润的季风气候，促进了植物区系的转变和快速发展。

冰期转移到避难所，冰后期重新扩张分布

New Phytologist
Research

Geological and ecological factors drive cryptic speciation of yews in a biodiversity hotspot

Jie Liu[1,2,3], Michael Möller[1,4], Jim Provan[5], Lian-Ming Gao[1], Ram Chandra Poudel[1,2,3] and De-Zhu Li[1,2]
[1]Key Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China; [2]Plant Germplasm and Genomics Center, Germplasm Bank of Wild Species, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China; [3]University of Chinese Academy of Sciences, Beijing 100049, China; [4]Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, UK; [5]School of Biological Sciences, Queen's University Belfast, 97 Lisburn Road, Belfast BT9 7BL, UK

Molecular Phylogenetics and Evolution xxx (2011) xxx–xxx

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Molecular Phylogenetics and Evolution
journal homepage: www.elsevier.com/locate/ympev
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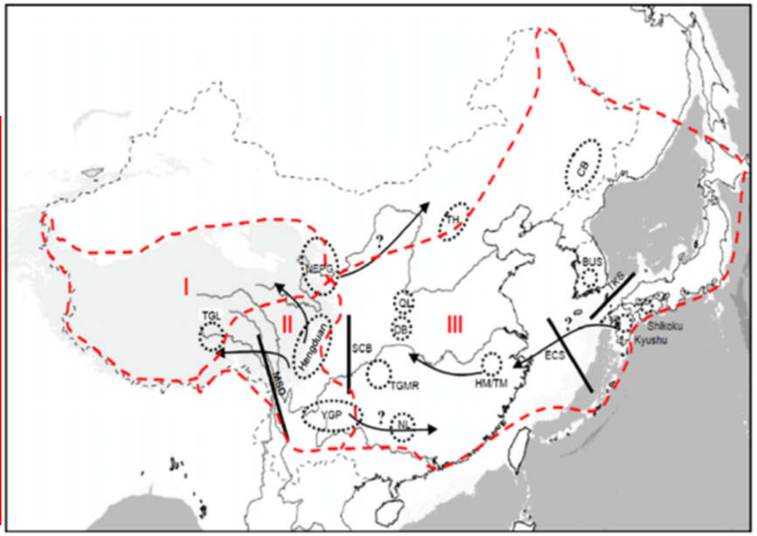
Review

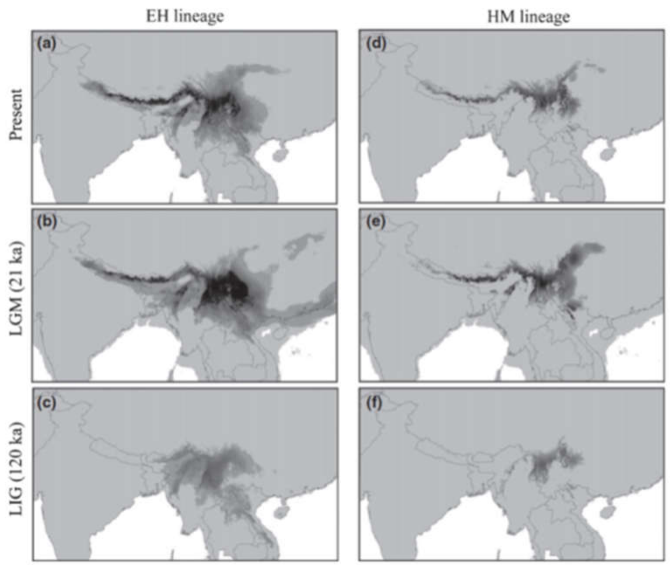
Plant molecular phylogeography in China and adjacent regions: Tracing the genetic imprints of Quaternary climate and environmental change in the world's most diverse temperate flora

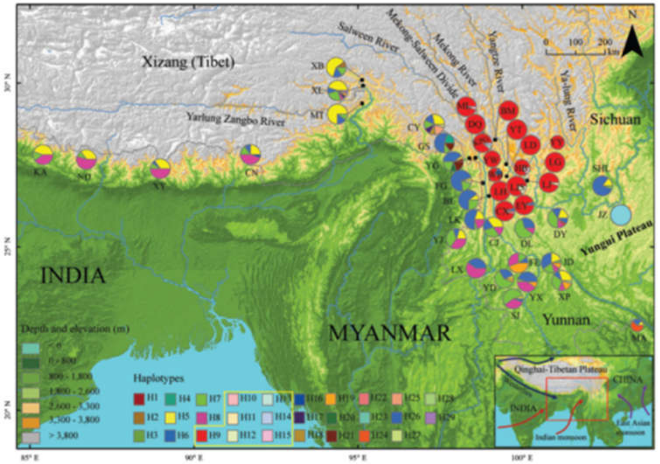
Ying-Xiong Qiu[a,b,*], Cheng-Xir
[a] Key Laboratory of Conservation Biology for Endan
[b] Laboratory of Systematic & Evolutionary Botany a
Zhejiang University, China
[c] Department of Organismic Biology, Salzburg Unive

冰期植物的避难所，冰期间冰期的交替，加速了物种的基因交流



红豆杉的研究表明冰期作用是驱动红豆杉遗传分化的驱动力

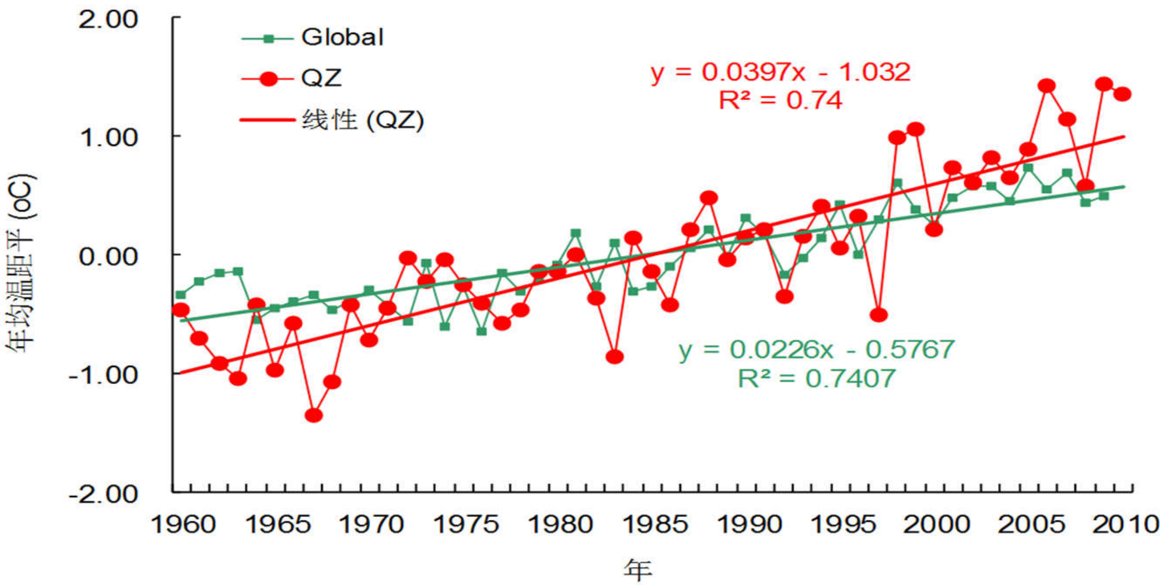




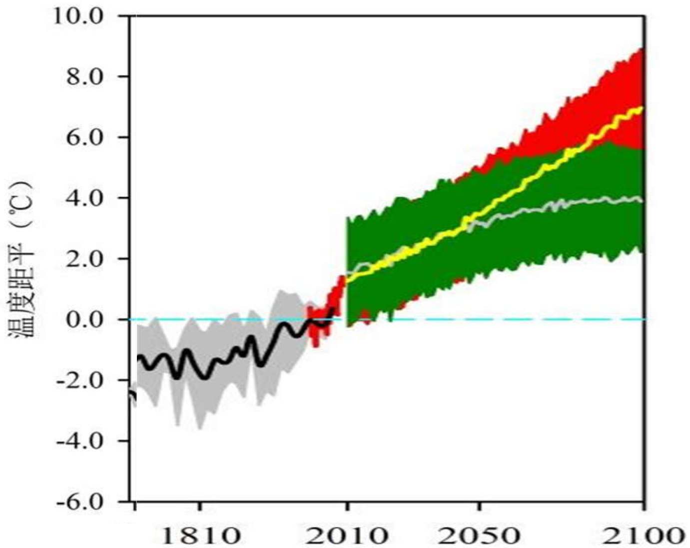
报告提纲

- 第一次青藏科考的丰硕成果
- 半个世纪来对高原植物的认识
- 青藏高原植物研究的展望

青藏高原正在经受剧烈的气候变化

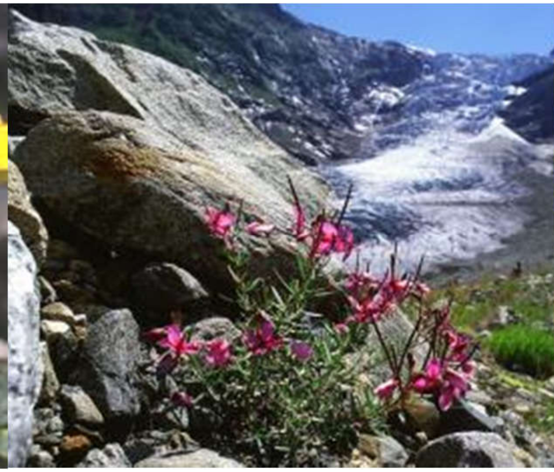


1960-2012年，青藏高原升温率0.3-0.4℃/10年，超过全球同期平均升温率的2倍



巴黎气候大会设定全球升温2℃，这一地区升温估计高达4℃.






3.1 气候变化对青藏高原生态系统影响研究



Winter and spring warming result in delayed spring phenology on the Tibetan Plateau

Haiying Yu[a,b], Eike Luedeling[c], and Jianchu Xu[a,b,1]

[a]Key Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650204, China; [b]World Agroforestry Centre, East-Asia Program, Kunming 650204, China; and [c]World Agroforestry Centre, Gigiri, Nairobi 00100, Kenya

Edited by F. Stuart Chapin, University of Alaska, Fairbanks, AK, and approved October 25, 2010 (received for review August 23, 2010)

Climate change has caused advances in spring phases of many plant species. Theoretically, however, strong warming in winter could slow the fulfillment of chilling requirements, which may delay spring phenology. This phenomenon should be particularly pronounced in regions that are experiencing rapid temperature increases and are ments and thus lead to later onset of spring phases. The large proportion of plant species that have shown advancing phenology in recent decades suggests that effects of rising spring temperatures so far outweigh the possibly delaying impact of winter warming in most cases. However, plant species that are particularly sensitive

Yu (2010)认为：冬季的升温可能会使冬季休眠植物所需的低温满足时间推迟，从而导致草原返青期推后。推断继续升高的气温可能会逆转现在多数植物生长季延长的现象，大大缩短植物的生长季。

Yu et al, 2010. PNAS

LETTER

No evidence of continuously advanced green-up dates in the Tibetan Plateau over the last decade

寒区草地生态系统春季物候会敏感地对气候变化会做出响应----春季变暖会导致返青期明显提前。由于青藏高原广泛存在的春季雪、冰等不利因素极易影响该植被指数的数据质量，从而导致提取的物候变化特征存在较大偏差。研究表明：**青藏高原近十余年春季温度快速上升，但是在区域尺度上的植被返青期并没有显著提前。**

Shen et al, 2013. PNAS

PNAS

Green-up dates in the Tibetan Plateau have continuously advanced from 1982 to 2011

Geli Zhang[a], Yangjian Zhang[a,1], Jinwei Dong[b], and Xiangming Xiao[b]

[a]Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China; and [b]Department of Microbiology and Plant Biology, Center for Spatial Analysis, University of Oklahoma, Norman, OK 73019

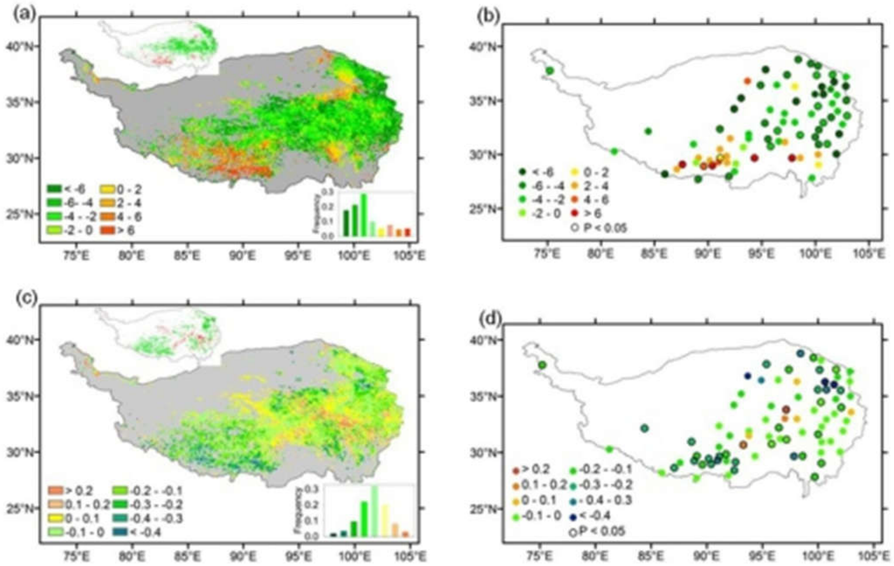
Edited by Robert E. Dickinson, The University of Texas at Austin, Austin, TX, and approved February 1, 2013 (received for review June 18, 2012)

As the Earth's third pole, the Tibetan Plateau has experienced a pronounced warming in the past decades. Recent studies reported that the start of the vegetation growing season (SOS) in the Plateau showed an advancing trend from 1982 to the late 1990s and a delay from the late 1990s to 2006. However, the findings regarding the SOS delay in the later period have been questioned, and the reasons causing the delay remain unknown. Here we explored

steppe and meadow also underwent an SOS advancement from 1982 to the end of the 1990s, but an SOS delay was found from the end of the 1990s to 2006 (10, 11, 15, 17). Several explanations for this trend of reversal were proposed but remain controversial (10, 11, 15, 17–21). One study based on MODIS NDVI data showed that the alpine vegetation SOS advanced in 60% of this region in the Northern Tibetan Plateau from 2001 to 2010 (22).

在过去30年中，青藏高原大部分地区的物候期明显提前。有的地区提前达到近一个月左右。说明青藏高原植被生态系统对全球变化有着明显的正响应。生长季的提前就可以为当地牧民提供更长时间的草资源，研究结果为当地经济发展及政策的制定提供了理论依据。

Zhang et al, 2013. PNAS



Global Change Biology

Explore this journal >

Primary Research Article

Precipitation impacts on vegetation spring phenology on the Tibetan Plateau

Miaogen Shen, Shilong Piao, Nan Cong, Gengxin Zhang, Ivan A Jassens

First published: 19 June 2015 Full publication history

降水对青藏高原返青期的影响。研究发现冬季降水对高原植被返青有直接影响，冬季降水增加导致返青期提前，越干旱的地区提前作用越强。冬季降水调节返青对温度的响应，越湿润的地区，返青期对冬季温度的敏感性越高。水分对高原植被物候的影响不可忽视，但目前多数生态系统过程模型并未考虑冬季降水，包括部分IPCC5使用的陆面模式。

nature COMMUNICATIONS

Leaf onset in the northern hemisphere triggered by daytime temperature

Shilong Piao, Jianguang Tan, Anping Chen, Yongshuo H. Fu, Philippe Ciais, Qiang Liu, Ivan A. Janssens, Sara Vicca, Zhenzhong Zeng, Su-Jong Jeong, Yue Li, Ranga B. Myneni, Shushi Peng, Miaogen Shen & Josep Peñuelas

物候对气候变化的响应研究全球变化研究的热点。研究发现：植被生长季开始日期与其之前1-3个月的温度关系显著，尤其是与白天温度；而晚上温度对植被春季物候的影响较小。由于全球变化背景下夜间变暖速率大于白天变暖速率，当前物候模型（大多基于日均温模拟植被物候）高估了未来气候变化情景下北半球植被春季物候的变化。

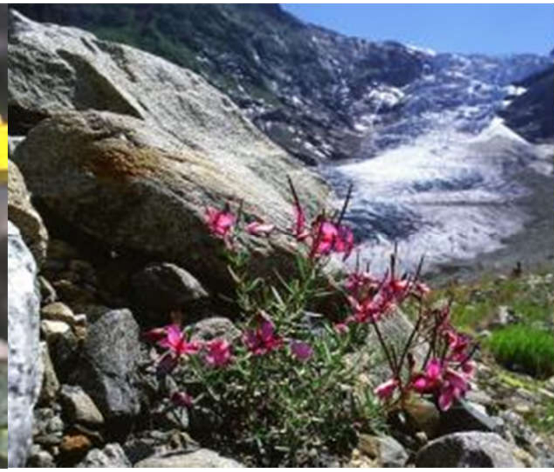
nature COMMUNICATIONS

Evidence for a weakening relationship between interannual temperature variability and northern vegetation activity

北半球植被对全球变暖响应的时空变化。上世纪80年代和90年代中期气候变暖显著促进北半球植被生产力，但最近15年其关系并不显著。高纬地区植被生产力与温度的关系在温暖年份显著低于寒冷年份，而且温暖年份的下降趋势比寒冷年份更为显著。过去30年来，青藏高原植被生长对温度变化的响应并没有显现出明显的动态变化规律，与北半球高纬地区植被并不一致，需要进一步分析。

关于青藏高原草地生态系统返青期对气候变化的响应研究。上世纪80和90年代加剧变暖导致高原返青期提前达15-18天，约为同期北半球平均的3倍。过去的十余年高原继续快速升温，区域平均返青期却并未呈现明显变化趋势，推测西南地区春季降水减少引起水分不足，导致返青期推后。






3.2 模拟增温下的草地生态系统变化研究



ECOLOGY LETTERS

Explore this journal >

Experimental warming causes large and rapid species loss, dampened by simulated grazing, on the Tibetan Plateau

Julia A. Klein, John Harte, Xin-Quan Zhao

Global Change Biology

Explore this journal >

Dynamic and complex microclimate responses to warming and grazing manipulations

Julia A. Klein, John Harte, Xin-Quan Zhao

ECOLOGICAL APPLICATIONS

ECOLOGICAL SOCIETY OF AMERICA

EXPERIMENTAL WARMING, NOT GRAZING, DECREASES RANGELAND QUALITY ON THE TIBETAN PLATEAU

Julia A. Klein, John Harte, Xin-Quan Zhao

Global Change Biology

Explore this journal >

Effect of warming and grazing on litter mass loss and temperature sensitivity of litter and dung mass loss on the Tibetan plateau

温度升高可降低高寒草甸植物物种多样性和牧草营养品质，合理放牧可以减轻增温引起物种丧失的负面效应。夜间比白天的增温幅度大可以加速高寒草甸凋落物的分解，随着未来温暖化条件下载蓄量的增加，通过凋落物生物量的减少和粪便产量的增加放牧将加强碳从土壤中释放到大气。

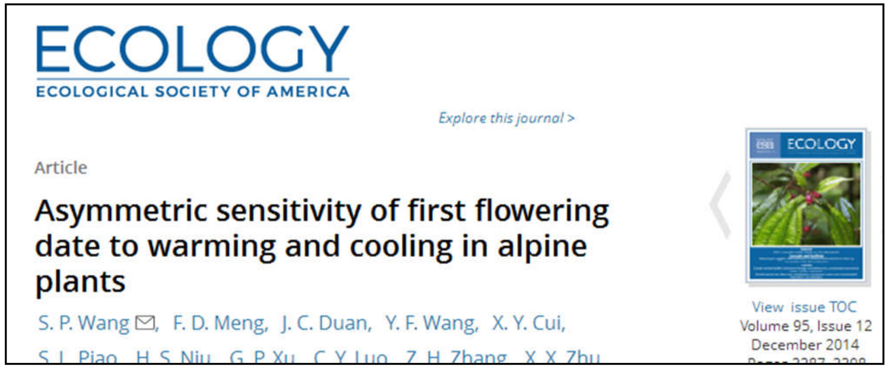

ECOLOGY

Article

Effects of warming and grazing on soil N availability, species composition, and ANPP in an alpine meadow

Shiping Wang, Jichuang Duan, Guangping Xu, Yanfen Wang,

View issue TOC
Volume 93, Issue 11
November 2012


ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

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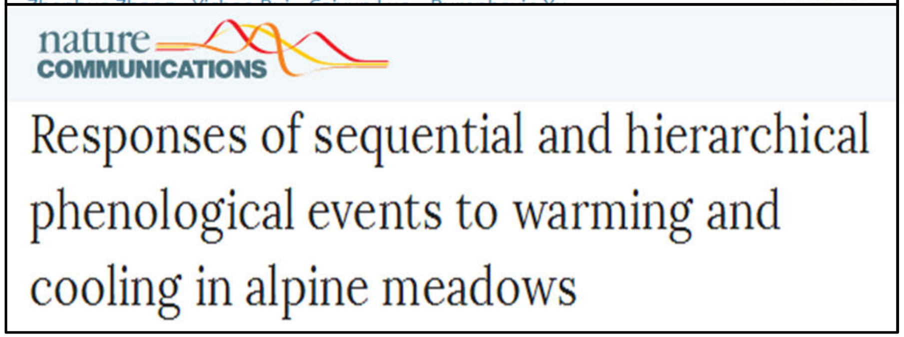
Article

Asymmetric sensitivity of first flowering date to warming and cooling in alpine plants

S. P. Wang, F. D. Meng, J. C. Duan, Y. F. Wang, X. Y. Cui,

View issue TOC
Volume 95, Issue 12
December 2014


nature COMMUNICATIONS

Responses of sequential and hierarchical phenological events to warming and cooling in alpine meadows


ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

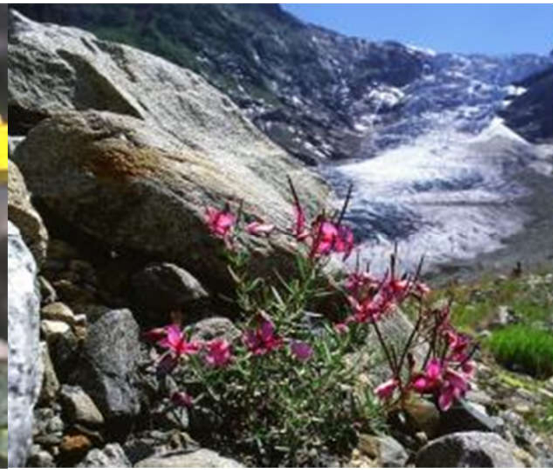
Changes in flowering functional group affect responses of community phenological sequences to temperature change

View issue TOC
Volume 98, Issue 3
March 2017

短期增温显著的提前了所有物候序列初始期，延迟了枯黄期；短期增温会显著的降低早花植物功能群的盖度，提高中花植物功能群的盖度，但降温的效应与增温的效应相反。

增温主要延长了高寒植物的开花期，进而延长了植物繁殖期和整个生长季；而降温主要缩短了高寒植物的果后营养期和枯黄期，进而缩短了营养期和整个生长季。






3.3 森林生态系统树线变化研究

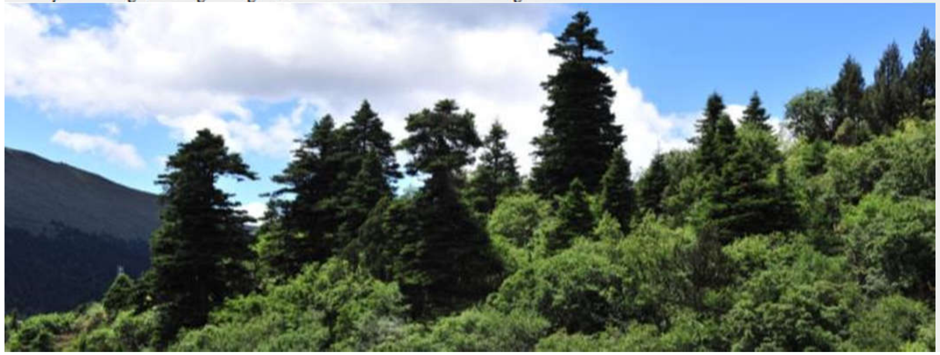


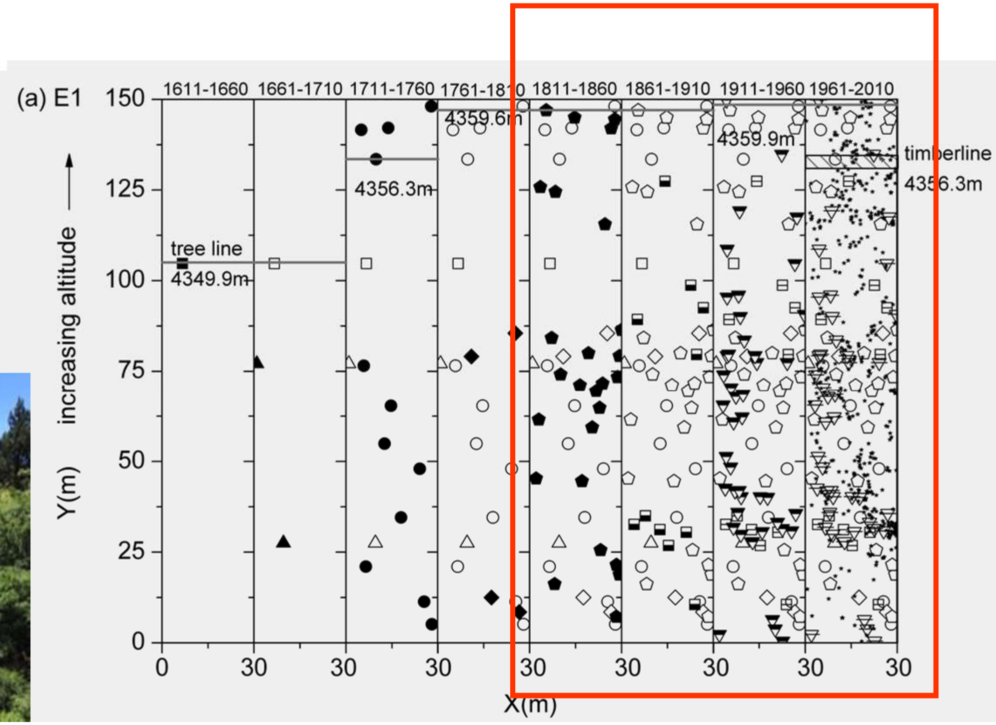
Research

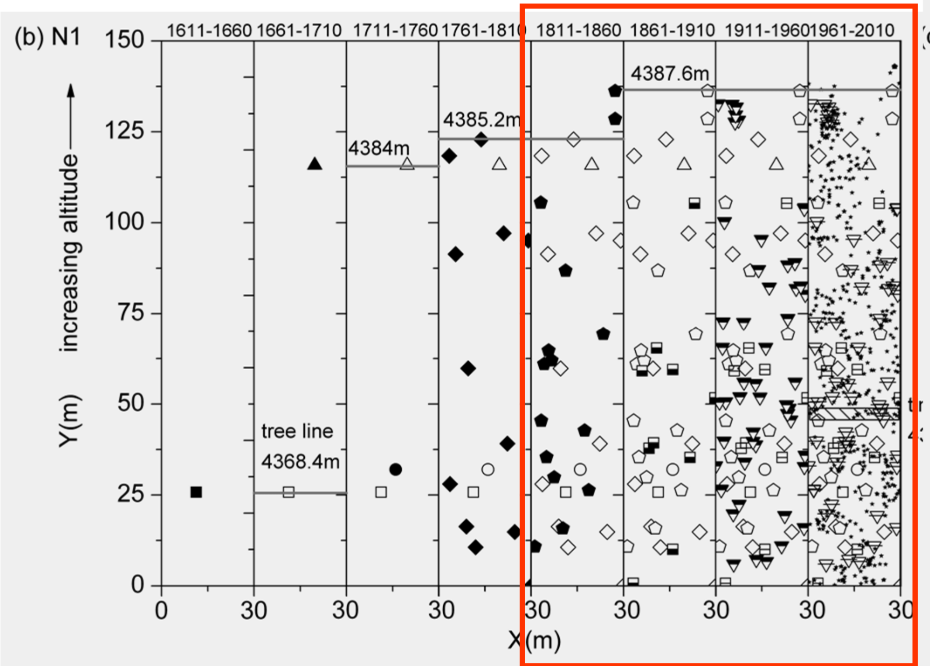
New Phytologist

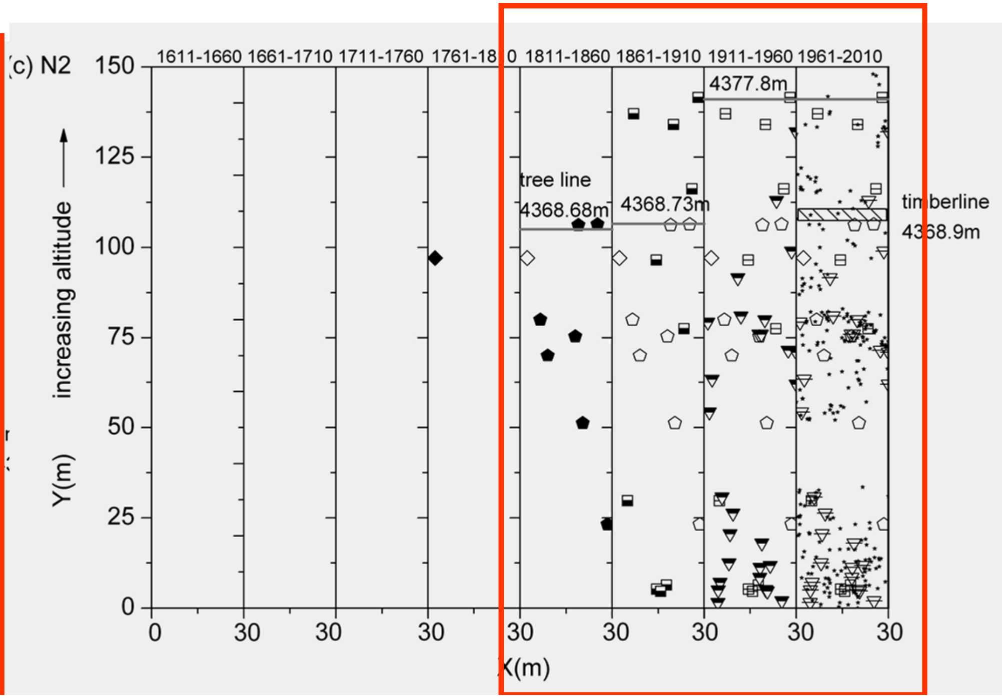
Little change in the fir tree-line position on the southeastern Tibetan Plateau after 200 years of warming

Eryuan Liang[1], Yafeng Wang[1,3], Dieter Eckstein[2] and Tianxiang Luo[1]









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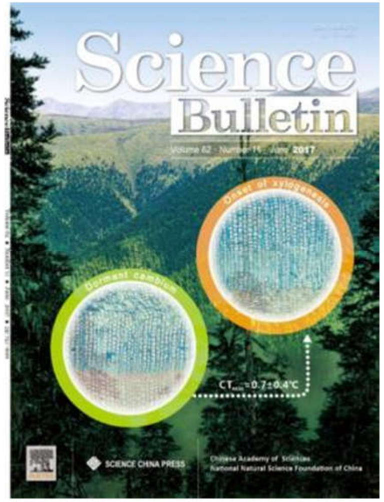
Science Bulletin

Volume 62, Issue 11, 15 June 2017, Pages 804-812



Article

Critical minimum temperature limits xylogenesis and maintains treelines on the southeastern Tibetan Plateau

Xiaoxia Li [a], Eryuan Liang [a, b], Jozica Gričar [c], Sergio Rossi [d, e], Katarina Čufar [f], Aaron M. Ellison [g]

高山树线对气候变化具有潜在的敏感性，是全球变化研究的热点。以藏东南色季拉山天然急尖长苞冷杉树线为研究对象， 在2个树线样点开展了连续3-4个生长季的形成层活动和微气象的同步监测研究。研究发现，大气最低温是影响木质部生长的主要气候因素，而且存在限制木质部分化开始的最低温阈值（0.7±0.4℃），远低于以往温带和寒温带森林木质部分化研究中所报道的最低温阈值（4-5℃）。

Species interactions slow warming-induced upward shifts of treelines on the Tibetan Plateau

Eryuan Liang[a,b,c,1], Yafeng Wang[a], Shilong Piao[a,c], Xiaoming Lu[a], Jesús Julio Camarero[d], Haifeng Zhu[a], Liping Zhu[b,c], Aaron M. Ellison[e], Philippe Ciais[f], and Josep Peñuelas[g,h]

[a]Key Laboratory of Alpine Ecology and Biodiversity, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China; [b]Key Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China; [c]CAS Center for Excellence in Tibetan Plateau Earth Sciences, Beijing 100101, China; [d]Instituto Pirenaico de Ecología, Consejo Superior de Investigaciones Científicas (IPE-CSIC), 50059 Zaragoza, Spain; [e]Harvard Forest, Petersham, MA 01366; [f]Laboratoire des Sciences du Climat et de l'Environnement, Commissariat a l'Energie Atomique CNRS, l'Université de Versailles Saint-Quentin, 91191 Gif sur Yvette, France; [g]CSIC, Global Ecology Unit Centre de Recerca Ecològica i Aplicacions Forestals (CREAF)-CSIC-UAB, Cerdanyola del Vallès, E-08193 Catalonia, Spain; and [h]CREAF, Cerdanyola del Vallès, E-08193 Catalonia, Spain

过去100年来14个固定样地树线位置的时空变化动态,发现9块样地树线位置上升13-80米，5块样地保持相对静止状态或仅小幅度上升（0-5米）。在气候变暖背景下，树线位置倾向于向更高海拔爬升，但爬升速率受到树线之上高山灌丛或草本植物盖度和高度的调控，种间竞争则会抑制树线的爬升。尽管不同样地树线爬升幅度不同，所有树线种群密度在过去50年来均呈显著增加趋势。

未来青藏高原植物多样性研究之展望

- 研究空间的变化（青藏高原-第三极-泛第三极）
- 植物多样性研究的核心是“变化及其机理”
- “变化”的研究要求时间尺度具连续监测数据，机理的研究需宏观监测与多重组学微观技术相结合
- 揭示青藏高原环境变化机理，优化生态安全屏障体系，推动青藏高原可持续发展、推进国家生态文明建设、促进全球生态环境保护

谢谢各位老师　敬请批评指正！