DOI: 10.47743/saa-2025-31-1-10

# The Acts of the Church Synods of Orange (441) and Vaison (442) and the Role of the Bishop in Late Antique Gaul

Martin ŠENK<sup>1</sup>

**Abstract.** This article examines the role of the Gallic episcopate in responding to the social and political crises of the fifth century, particularly through the lens of two early synods held in Orange (441) and Vaison (442). While the period was marked by the collapse of Roman administrative structures and the increasing vulnerability of local populations, the Gallic Church - and especially its bishops - began to assume key social functions that had been previously managed by the imperial state. The synodal canons from Orange and Vaison reveal early and systematic efforts by bishops to protect the poor and assert ecclesiastical authority over both spiritual and material realms. In particular, the acts emphasise episcopal responsibility for safeguarding Church property and the rights of the vulnerable, especially through the institution of ecclesiastical asylum. Canon 4 of the Synod of Vaison, which condemns those who withhold bequests to the Church as "murderers of the poor," illustrates the moral and rhetorical strategies used to legitimise episcopal power. These developments are interpreted within the broader framework of Bischofsherrschaft (or "episcopal rule") understood as a gradual and context-specific process.

Rezumat. Prezentul articol investighează rolul episcopatului galic în gestionarea crizelor sociale și politice din secolul al V-lea, cu precădere prin intermediul a două sinoade timpurii desfăsurate la Orange (441) și Vaison (442). Într-un context istoric marcat de dezaareaarea structurilor administrative romane si de vulnerabilitatea accentuată a comunitătilor locale, Biserica galică - si, în mod special, corpul episcopal - a început să îsi asume funcții sociale esentiale, anterior atribuite aparatului statal imperial. Canoanele sinodale de la Orange si Vaison evidentiază eforturi incipiente si sistematice ale episcopilor de a proteja categoriile defavorizate si de a consolida autoritatea ecleziastică asupra domeniilor spirituale și materiale deopotrivă. În mod particular, actele accentuează responsabilitatea episcopală privind ocrotirea patrimoniului bisericesc și garantarea drepturilor celor vulnerabili, mai ales prin instituția azilului ecleziastic. Canonul 4 al Sinodului de la Vaison, care îi denunță pe cei ce refuză transmiterea legatelor către Biserică drept "uciqași ai săracilor", constituie o ilustrare grăitoare a strategiilor morale și retorice prin care se legitima puterea episcopală. Aceste transformări sunt interpretate în cadrul mai amplu al conceptului de Bischofsherrschaft (sau "domnia episcopală"), înteles ca un proces gradual si dependent de context.

Keywords: Gaul, migration period, church synods, episcopal rule, Gallic episcopate

### Introduction

During the fifth and sixth centuries, the population of Gaul faced a series of crises. Following the incursion of the Alans, Suebi, and Vandals into Gaul in 406, the region experienced the expansion of the Franks, Burgundians, and Visigoths, uprisings of the rural population (the so-called Bagaudae revolts), and campaigns led by Hunnic tribal confederations. The inhabitants of Gaul also suffered the effects of climatic change associated with the onset of the Late Antique Little Ice Age. Of course, not all regions of Gaul were in a

<sup>&</sup>lt;sup>1</sup> Institute of Auxiliary Historical ScQiences and Archive Studies, Faculty of Arts, Masaryk University; martin.senk@phil.muni.cz

state of constant crisis during this time. Some areas, for instance, were spared the immediate devastations of the Migration Period, only to be afflicted later during the Merovingian civil wars in the latter half of the sixth century – and vice versa.

In describing developments in Gaul, what matters is not so much a catalogue of individual conflicts and disasters, but rather the structural perspective. At the beginning of the fifth century, the Roman state abruptly lost its ability to intervene effectively in Gallic affairs - the imperial centre could no longer reliably maintain even basic administration, and in military terms, the Gallic population was left to fend for itself. As a consequence, the wealthy class of Gallic landowners and aristocrats was compelled to respond to unfolding events independently of Roman central governance, while simultaneously needing to legitimise its leadership and administrative role in the various regions without recourse to Roman structures of legitimation. The Gallo-Roman aristocracy sought to make the best of the situation by preserving its power within the cities and, from there, maintaining control over the surrounding countryside. This gave rise to a unique trajectory of development in Gaul, unmatched elsewhere in the crumbling Western Roman Empire. The traditional Gallo-Roman elite turned to the only functioning alternative administrative structure available – that of the Christian Church, and above all, the authority embodied in the office of the Christian bishop. By securing control of episcopal sees, the Gallo-Roman aristocracy was able to govern local regions effectively and to establish urban centres for economic distribution. In the Gallic context, bishops from the fifth century onward increasingly assumed functions once held by Roman civil administration - organising aid for the poor and needy, overseeing construction and urban maintenance, defending cities, or managing land improvement. A significant number of Gallic episcopal seats were occupied by members of the Gallo-Roman aristocracy (in some cases, the episcopal office appears almost hereditary), making the bishopric from an early point a highly lucrative position endowed with substantial influence and authority. This transformation contributed significantly to the alliance between the Franks and the Gallic Catholic Church, which would become one of the main pillars of Frankish governance and power in Gaul. Since the 1970s, scholarship has interpreted this specific development of the Gallic episcopate through the concept of Bischofsherrschaft<sup>2</sup>. It is precisely through the lens of Bischofsherrschaft that the surviving acts of the Gallic synods of Orange (441) and Vaison (442) may be contextualised and analysed - texts that, unlike the synodal conclusions from the Merovingian period, have received comparatively little scholarly attention<sup>3</sup>.

# The Acts of the Synods of Orange (441) and Vaison (442) as a reflection of the changing role of the bishop in Gallic society

Our understanding of the role of Gallic bishops in society and the evolving ideal of the episcopal office is informed by a wide range of sources – from the chronicle of Gregory of Tours to various collections of letters, poems and panegyrics, hagiographic writings, and even

rlaa a

<sup>&</sup>lt;sup>2</sup> The debate was opened by F. Prinz with a thought-provoking article PRINZ 1973. F. Prinz was soon followed by a number of authors who further developed his theses – cf. in particular HEINZELMANN 1976; GASSMANN 1977; KAISER 1981; HEINZELMANN 1988; KAISER 1988; PRINZ 1988; 1989; BAUMGART 1995. A fundamental revision and revival of the concept then came with JUSSEN 1995. More recently, see ANTON 1996a; 1996b; PATZOLD 2010; 2014 (who is highly critical to the concept, especially to the alleged senatorial origin of the majority of Gallic bishops); DIEFENBACH 2013; ŠENK 2021; ZIMMERMANN 2022.

<sup>&</sup>lt;sup>3</sup> The editions were published by MUNIER (ed.) 1963, 74–93; 94–104, but in both cases without taking into account all manuscripts. The latest editions are presented by SCHOLZ 2022, 30–45; 46–59, who improved and corrected the editions.

epigraphic evidence. A particularly intriguing corpus of sources on this topic is the acts of Gallic church synods. However, it is important to bear in mind that numerous synods took place in the Gallic context whose acts have not survived; we know of them only indirectly through other sources, or, in some cases, not at all. It can therefore be assumed that the topics discussed below were addressed at a greater number of synods than can be attested on the basis of the extant records.

Here, attention is first given to the acts of the Gallic episcopal synod held in 441 at Orange, presided over by the metropolitan bishop Hilary of Arles. The synod convened at a critical moment in Gallic history – during the episcopates of prominent bishops such as Germanus of Auxerre, Lupus of Troyes, and Anianus of Orléans, who were compelled to engage actively in diplomatic negotiations and to protect their congregations from a range of threats. Both the diplomacy and the challenges of the turbulent Migration Period also left a marked impact on the episcopate of Hilary of Arles himself<sup>4</sup>. A close reading of the synodal acts from this period – a time marked by Bagaudae uprisings and incursions of barbarian forces into Gallic territory – offers an important complement to the image of the era otherwise shaped primarily by episcopal hagiographies and the fragmentary testimony of late Roman authors.

The proceedings of the Synod of Orange culminated on 8 November, when the bishops signed the synodal acts. From these acts we learn, above all, that the synod was attended by seventeen bishops, along with several other clerics. Except for one bishop from Hispano-Galician territory, the synod represented a gathering of bishops from the south-eastern region of Gaul<sup>5</sup>. This area had, in the preceding years, been the scene of considerable upheaval. In the 430s, the region around Arles and Narbonne had repelled several Gothic assaults. Following the collapse of the Burgundian kingdom on the Rhine in 435 or 436, the south-eastern frontier of Gaul was plunged into further instability – especially as Roman military attention was attracted by Bagaudae uprisings in the north. The situation escalated in 443, when Aëtius ceded the territory of "Sapaudia", near Lake Geneva, to the Burgundians. The local Gallic bishops now found themselves confronted with the proximity – and soon the dominance – of Burgundian power<sup>6</sup>.

On the eve of the Burgundians' settlement near Lake Geneva, a synod convened in south-eastern Gaul – a gathering that can reasonably be assumed to have responded, in certain respects, to the challenges of a time of crisis. The synodal acts contain twenty-eight, or in some manuscripts thirty, canons (the numbering of the canons varies across manuscript traditions). Two of these canons – numbers 5 and 6 (7) – offer particularly striking insight into the role of the Church during this turbulent period, as they address the issue of ecclesiastical asylum. According to these canons, individuals who seek refuge in a church are not to be surrendered, but are to be protected, both on account of the sanctity of the place (the church itself) and through the intercession of ecclesiastical authority. Anyone who believes they can lay claim to slaves belonging to clergy after these slaves have sought sanctuary in the church is to be subjected to the severest ecclesiastical condemnation. Likewise, any individual who attempts

<sup>&</sup>lt;sup>4</sup> For a basic summary of sources and historical information, see, for example, GASSMANN 1977, passim; BAUMGART 1995, passim.

<sup>&</sup>lt;sup>5</sup> SCHOLZ 2022, 44.

<sup>&</sup>lt;sup>6</sup> A basic overview, including references to sources and further literature, is provided, for example, by HALSALL 2007, 242–254; MEIER 2019, 441–444.

<sup>&</sup>lt;sup>7</sup> "Eos qui ad ecclesiam confugerint tradi non oportere, sed loci reuerentia et intercessione defendi. Si quis autem mancipia clericorum pro suis mancipiis ad ecclesiam confugientibus crediderit occupanda, per omnes ecclesias districtissima damnatione feriatur." SCHOLZ 2022, 34, canon 5.

to reduce to slavery, subjugate, or otherwise bind into servile dependence those who were freed within a church or entrusted to the Church through testamentary provision is also to be punished by ecclesiastical penalty. These two canons thus reveal an increase in the role of the Gallic Church in offering protection to the lowest classes of society. As S. Esders has noted, the church now claimed protective power not only over the former slaves who had been entrusted to it by will, but also over those who had been manumitted under its auspices.

The active protection of society's most vulnerable members became, in the sixth century, a defining feature of the ecclesiastical and episcopal ideal <sup>10</sup>. The canons of the Synod of Orange suggest, however, that the first systematic steps in this direction had already been taken in the early 440s. This is hardly in doubt, for already in 442, a synod was convened at Vaison, whose acts are even more explicit in this regard.

The acts of the synod, comprising ten canons, were approved by twenty-three attending bishops on 23 November 442. The synod once again took place in south-eastern Gaul, in a diocese under the metropolitan authority of Arles, and all episcopal participants came exclusively from this south-eastern Gallic region. It remains uncertain whether the synod was presided over once more by bishop Hilary of Arles (as local metropolitan) or by bishop Auspicius of Vaison, who is listed first among the signatories<sup>11</sup>.

From the perspective of the issue under examination, two canons are of particular interest: canon number 6, in which the participants of the Synod of Vaison sought to reinforce the authority of bishops within their episcopal cities<sup>12</sup>, and especially canon number 4, which merits considerable attention. In this canon, the bishops introduced a new argument concerning the protection of Church property. According to canon number 4, those who withhold gifts (offerings) made by deceased believers and delay in handing them over to the Church are to be excluded from the ecclesial community as unbelievers. Such behaviour, the synodal acts argue, runs counter to divine mercy and ultimately leads to the collapse of faith itself. For in depriving the dying of the fulfilment of their vows and the poor of nourishment and essential sustenance, these individuals undermine both charity and piety. Indeed, those who seize Church property are, according to this canon, to be regarded as murderers of the poor and as people who do not believe in the judgment of God<sup>13</sup>.

The Synod of Vaison thus advanced the theory that those who plunder Church property deprive the poor of the means of their support and sustenance – and are therefore to be regarded as murderers. The intention to protect not only ecclesiastical assets but also the poor and needy is made fully explicit here. As has long been recognised in scholarship, the Church – and, at its head, the Gallic episcopate – increasingly assumed the responsibilities of social care and the maintenance of civic peace as Roman municipal administration gradually lost the

<sup>&</sup>lt;sup>8</sup> "In ecclesia manumissos, uel per testamentum ecclesiae commendatos si quis in seuitutem uel obsequium uel ad colonariam conditionem imprimere tentauerit, animaduersione ecclesiastica coercebitur." SCHOLZ 2022, 36, canon 6 (7).

<sup>9</sup> ESDERS 2010, 34-35.

<sup>&</sup>lt;sup>10</sup> See, for example, BAUMGART 1995; ZIMMERMANN 2022.

<sup>&</sup>lt;sup>11</sup> SCHOLZ 2022, 56; 58.

<sup>&</sup>lt;sup>12</sup> SCHOLZ 2022, 52; 54, canon 4.

<sup>&</sup>lt;sup>13</sup> "Qui oblationes defunctorum fidelium detinent et ecclesiae tradere demorantur, ut infideles sunt ab ecclesia abiiciendi, quia usque ad exinanitionem fidei peruenire certum est hanc pietatis diuinae exacerbationem, qua et fideles de corpore recendentes uotorum suorum plenitudine et pauperes collatu alimoniae et necessaria sustentatione fraudantur. Tales enim quasi egentium necatores nec credentes iudicium Dei habendi sunt unius quoque patrum in hoc, quam scriptis suis inseruit, congruente sententia qua ait: amico quidpiam rapere furtum est, ecclesiam fraudere sacrilegium." SCHOLZ 2022, 52, canon 4. See also ZIMMERMANN 2022, 138–139.

capacity to provide for the indigent<sup>14</sup>. The acts of the Synod of Vaison strongly reinforce this interpretation. This hypothesis can further be supported by examining the reception of this particular canon: the synod's conclusions regarding care for the poor entered wider ecclesiastical consciousness, as evidenced by an explicit reference to them in the acts of the Synod of Arles, held between 490 and 502<sup>15</sup>. They were also taken up and expanded upon by the Synod of Agde in 506<sup>16</sup>, which adapted the principle to questions concerning the sale and lease of property – with particular emphasis placed on the role of the bishop in overseeing such activities<sup>17</sup>.

## Conclusion

Gaul has long been regarded as an example of a successful response to the crises of the Migration Period. For several decades, scholarship has emphasised the active role of the Gallic Church - and in particular of the Gallic episcopate - as a decisive factor in this success. The role of the bishop in society is also reflected in the acts of Gallic synods. While these texts do not offer a vivid picture of episcopal involvement in diplomacy or military defence of dioceses, they do, in various respects, illuminate the practical dimensions of episcopal office. As the analysis of the synodal acts reveals, in a time marked by emerging social and political instability, bishops directed their efforts toward aiding the most vulnerable members of society. Both synods, held in south-eastern Gaul, indicate that bishops had become acutely aware of their new responsibility for the poor and helpless Christian population - and that they took the first systematic steps toward its protection. There was no doubt many motives behind this program, but one may reasonably conclude that, in effect, care for those in need became a key argument for Gallic bishops in asserting their authority and legitimising their control of Church property. Indeed, the acts of the Synod of Vaison show clearly that anyone who robbed the bishopric of material goods could be denounced as a murderer of the poor – a charge that offered bishops a far more tangible justification than abstract claims of sacrilege. The rise of episcopal authority - which may be framed within the concept of Bischofsherrschaft ("episcopal rule") - thus appears as a gradual process, closely linked to the growing responsibility of bishops within society and to the Church's assumption of key social functions in times of crisis.

<sup>14</sup> See especially JUSSEN 1995; 1997; 1998.

<sup>&</sup>lt;sup>15</sup> "Secundum constitutionem synodi Vasensis, quicumque oblationem fidelium suppresserit aut negauerit, ab ecclesia cui fraudem fecerit excludatur." SCHOLZ 2022, 78, canon 47.

<sup>&</sup>lt;sup>16</sup> "Clerici etiam uel saeculares, qui oblationes parentum aut donatas aut testamentis relictas retinere perstiterint, aut id quod ipsi donauerint ecclesiis uel monasteriis crediderint auferendum, sicut synodus sancta constituit, uelet necatores pauperum, quous que reddant, ab ecclesiis excludantur." SCHOLZ 2022, 88, canon 4.

<sup>&</sup>lt;sup>17</sup> "Casellas uero uel mancipiola ecclesiae episcopi, sicut prisca canonum praecepit auctoritas, uel uasa ministerii, quasi commendata fideli proposito integro ecclesiae iure possideant: id est, ut neque uendere neque per quoscumque contractus res unde pauperes uiuunt, alienare praesumant. Quod si necessitas certa compulerit, ut pro ecclesiae aut necessitate aut utilitate, uel in usufructu uel in directa uenditione aliquid distrahatur, apud duos uel tres comprouinciales uel uicinos episcopos causa, qua necesse sit uendi, primitus comprobetur; et habita discussione sacerdotali, eorum subscriptione quae facta fuerit uenditio roboretur; aliter facta uenditio uel transactio non ualebit. Sane si quos de seruis ecclesiae bene meritos sibi episcopus libertate donauerit, collatam libertatem a successoribus placuit custodire cum eo quod eis manumissor in libertatem contulerit: quod tamen iubemus uiginti solidorum numerum modum in terrola, uineola uel hospitiolo tenere. Quod amplius datum fuerit, post manumissoris mortem ecclesia reuocabit. Minusculas uero res aut ecclesiae minus utiles peregrinis uel clericis, saluo, iure ecclesiae, in usum praestare permittimus." SCHOLZ 2022, 88, canon 7.

### References

ANTON, H. H. 1996a. "Bischofsherrschaften" und "Bischofsstaaten" in Spätantike und Frühmittelalter. Reflexion zu ihrer Genese, Struktur und Typologie. In: F. Burgard, Ch. Cluse, A. Haverkamp (eds.). Liber amicorum necnon et amicarum für Alfred Heit: Beiträge zur mittelalterlichen Geschichte und geschichtlichen Landeskunde, Trier: Trierer Historische Forschungen, 461–473.

ANTON, H. H. 1996b. Bischof und civitas – Kirchliche Grundlagen und politische Dimensionen bischöflicher Amtsführung im Frankenreich. In: Reiss Museum Mannheim, Die Franken, Wegbereiter Europas. Vor 1500 Jahren: König Chlodwig und seine Erben (Vol. I), Mainz: Philipp von Zabern, 373–380.

BAUMGART, S. 1995. Die Bischofsherrschaft im Gallien des 5. Jahrhunderts: Eine Untersuchung zu den Gründen und Anfängen weltlicher Herrschaft der Kirche, Müchen: Editio Maris.

DIEFENBACH, S. 2013. "Bischofsherrschaft". Zur Transformation der politischen Kultur im spätantiken und frühmittelalterlichen Gallien. In: S. Diefenbach, G. M. Müller (eds.). *Gallien in Spätantike und Frühmittelalter: Kulturgeschichte einer Region*, Berlin: De Gruyter, 91–152.

ESDERS, S. 2010. Die Formierung der Zensualität: Zur kirchlichen Transformation des spätrömischen Patronatswesens im früheren Mittelalter, Ostfildern: Thorbecke.

GASSMANN, P. 1977. Der Episkopat in Gallien im 5. Jahrhundert, Bonn: Rheinische Friedrich-Wilhelms-Universität.

HALSALL, G. 2007. *Barbarian Migrations and the Roman West 376–568*, Cambridge: Cambridge University Press.

HEINZELMANN, M. 1976. Bischofsherrschaft in Gallien. Zur Kontinuität römischer Führungsschichten vom 4. bis zum 7. Jahrhundert. Soziale, prosopographische und bildungsgeschichtliche Aspekte, Zürich-München: Artemis Verlag.

HEINZELMANN, M. 1988. Bischof und Herrschaft vom spätantiken Gallien bis zu den karolingischen Hausmeiern. Die institutionellen Grundlagen. In: F. Prinz (ed.). Herrschaft und Kirche. Beiträge zur Entstehung und Wirkungsweise episkopaler und monastischer Organisationsformen, Stuttgart: Anton Hiersemann, 23–82.

JUSSEN, B. 1995. Über "Bischofsherrschaften" und die Prozeduren politischsozialer Umordnung in Gallien zwischen "Antike" und "Mittelalter". *Historische Zeitschrift*, 260(1): 673–718.

JUSSEN, B. 1997. Zwischen Römischem Reich und Merowingern: Herrschaft legitimieren ohne Kaiser und König. In: P. Segl (ed.). Mittelalter und Moderne. Entdeckung und Rekonstruktion der mittelalterlichen Welt: Kongreßakten des 6. Symposiums des Mediävistenverbandes in Bayreuth 1995, Sigmaringen: Thorbecke, 15–29.

JUSSEN, B. 1998. Liturgie und Legitimation, oder: Wie die Gallo-Romanen das römische Reich beendeten. In: R. Blänker, B. Jussen (eds.). *Institutionen und Ereignisse: Über historische Praktiken und Vorstellungen gesellschaftlichen Ordnens*, Göttingen: Vandenhoeck & Ruprecht, 75–136.

KAISER, R. 1981. Bischofsherrschaft zwischen Königtum und Fürstenmacht. Studien zur bischöflichen Stadtherrschaft im westfränkisch-französischen Reich im frühen und hohen Mittelalter, Bonn: Ludwig Röhrscheid Verlag.

KAISER, R. 1988. Königtum und Bischofsherrschaft im frühmittelalterlichen Neustrien. In: F. Prinz (ed.). Herrschaft und Kirche. Beiträge zur Entstehung und Wirkungsweise episkopaler und monastischer Organisationsformen, Stuttgart: Anton Hiersemann, 83–108.

MEIER, M. 2019. Geschichte der Völkerwanderung: Europa, Asien und Afrika vom 3. bis zum 8. Jahrhundert n. Chr., München: C. H. Beck.

MUNIER, Ch. (ed.). 1963. Concilia Galliae A. 314 - A. 506, Turnhouti: Brepols.

PATZOLD, S. 2010. Zur Sozialstruktur des Episkopats und zur Ausbildung bischöflicher Herrschaft in Gallien zwischen Spätantike und Frühmittelalter. In: M. Becher, S. Dick (eds.). Völker, Reiche und Namen im frühen Mittelalter, München: Wilhelm Fink, 121–140.

PATZOLD, S. 2014. Bischöfe, soziale Herkunft und die Organisation lokaler Herrschaft um 500. In: M. Meier, S. Patzold (eds.). *Chlodwigs Welt: Organisation von Herrschaft um* 500, Stuttgart: Franz Steiner Verlag, 523–543.

PRINZ, F. 1973. Die bischöfliche Stadtherrschaft im Frankenreich vom 5. bis zum 7. Jahrhundert. *Historische Zeitschrift*, 217(1): 1–35.

PRINZ, F. 1988. Herrschaftsformen der Kirche vom Ausgang der Spätantike bis zum Ende der Karolingerzeit. Zur Einführung ins Thema. In: F. Prinz (ed.). Herrschaft und Kirche. Beiträge zur Entstehung und Wirkungsweise episkopaler und monastischer Organisationsformen, Stuttgart: Anton Hiersemann, 1–21.

PRINZ, F. 1989. Der fränkische Episkopat zwischen Merowinger- und Karolingerzeit. In: A. Haverkamp, A. Heit (eds.). Mönchtum, Kultur und Gesellschaft: Beiträge zum Mittelalter; zum sechzigsten Geburtstag des Autors, München: C. H. Beck, 199–244.

SCHOLZ, S. (ed.). 2022. Ausgewählte Synoden Galliens und des merowingischen Frankenreichs, Darmstadt: Wissenschaftliche Buchgesellschaft.

ŠENK, M. 2021. Proměna úlohy biskupa a biskupského ideálu v době stěhování národů. *Mediaevalia Historica Bohemica*, 24(2): 21–35. <u>https://doi.org/10.56514/mhb.22.02.02</u>

ZIMMERMANN, P. 2022. Armut und Bischofsherrschaft: Bischöfliche Fürsorge in der Merowingerzeit, Sonderband 63, Ostfildern: Thorbecke. <a href="https://doi.org/10.11588/vufsb.2022.63">https://doi.org/10.11588/vufsb.2022.63</a>



© 2024 by the authors; licensee Editura Universității Al. I. Cuza din Iași. This article is an open access article distributed under the terms and conditions of the Creative Commons by Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).