## Supplemental Material

Page S1. Table of Contents.

## Experimental Section

Page S2. $\quad$ Synthesis of $\mathbf{2}\{1\}$ and $\mathbf{2}\{2\}$.
Page S2-S4. Synthesis of $\mathbf{4}\{1-2,1-4\}$.
Page S4-S5. Synthesis of $5\{1-2,1-4\}$.
Page S5. Synthesis of $\mathbf{6}\{1-4\}$.
Page S5-S11. Synthesis of $7\{1-2,1-4,1-4\}$.
Page S11-S13. Synthesis of $\mathbf{8}\{1-2,1-4,1-4\}$.
Page S13-S17. Synthesis of $9\{1-2,1-4,1-4\}$.

## Supporting Analytical Data

| Page S17. | Figure S1. LC-MS of $\mathbf{9}\{1,1,1\}$. |
| :--- | :--- |
| Page S18. | Figure S2. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{1,1,1\}$. |
| Page S19. | Figure S3. LC-MS of $\mathbf{9}\{1,1,2\}$. |
| Page S20. | Figure S4. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{1,1,2\}$. |
| Page S21. | Figure S5. LC-MS of $\mathbf{9}\{1,1,3\}$. |
| Page S22. | Figure S6. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{1,1,3\}$. |
| Page S23. | Figure S7. LC-MS of $\mathbf{9}\{1,1,4\}$. |
| Page S24. | Figure S8. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{1,1,4\}$. |
| Page S25. | Figure S9. LC-MS of $\mathbf{9}\{1,2,2\}$. |
| Page S26. | Figure S10. ${ }^{1} \mathrm{H}-\mathrm{NMR} \mathrm{Spectra} \mathrm{of} \mathbf{9}\{1,2,2\}$. |
| Page S27. | Figure S11. LC-MS of $\mathbf{9}\{1,2,4\}$. |

Page S28. Figure S12. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{1,2,4\}$.
Page S29. Figure S13. LC-MS of $\mathbf{9}\{1,3,2\}$.
Page S30. Figure S14. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{1,3,2\}$.
Page S31. Figure S15. LC-MS of $9\{1,3,4\}$.
Page S32. Figure S16. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{1,3,4\}$.
Page S33. Figure S17. LC-MS of $\mathbf{9}\{1,4,2\}$.
Page S34. Figure S18. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{1,4,2\}$.
Page S35. Figure S19. LC-MS of $9\{1,4,3\}$.
Page S36. Figure S20. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{1,4,3\}$.

Page S37. Figure S21. LC-MS of $9\{2,1,2\}$.
Page S38. Figure S22. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{2,1,2\}$.
Page S39. Figure S23. LC-MS of $9\{2,1,3\}$.
Page S40. Figure S24. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{2,1,3\}$.
Page S41. Figure S25. LC-MS of $9\{2,2,2\}$.
Page S42. Figure S26. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{2,2,2\}$.
Page S43. Figure S27. LC-MS of $\mathbf{9}\{2,2,3\}$.
Page S44. Figure S28. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{2,2,3\}$.
Page S45. Figure S29. LC-MS of $9\{2,3,1\}$.
Page S46. Figure S30. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{2,3,1\}$.
Page S47. Figure S31. LC-MS of $9\{2,3,2\}$.
Page S48. Figure S32. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{2,3,2\}$.
Page S49. Figure S33. LC-MS of $9\{2,3,3\}$.
Page S50. Figure S34. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $9\{2,3,3\}$.
Page S51. Figure S35. LC-MS of $9\{2,4,1\}$.
Page S52. Figure S36. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{2,4,1\}$.
Page S53. Figure S37. LC-MS of $\mathbf{9}\{2,4,2\}$.
Page S54. Figure S38. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ Spectra of $\mathbf{9}\{2,4,2\}$.

## Synthesis


$\mathbf{2}\{1\}$. Alternative procedure: To an ice-cooled solution of $N, N$-dimethylethylenediamine ( 7.4 mL , $68.8 \mathrm{mmol})$ in dry THF ( 60 mL ) was added a solution of $\mathrm{Boc}_{2} \mathrm{O}(5.0 \mathrm{~g}, 22.9 \mathrm{mmol})$ in dry THF ( 40 mL ). The reaction mixture was stirred at $0^{\circ} \mathrm{C}$ for 30 min . then warmed to rt and stirred another 19.5 h . The reaction mixture was filtered and the filtrate concentrated under vacuum. The residue was dissolved in EtOAc, washed with brine ( $3 \times 50 \mathrm{~mL}$ ), dried over $\mathrm{MgSO}_{4}$, and concentrated under vacuum to yield $3.83 \mathrm{~g}(85 \%)$ of a colorless oil used without further purification. LC-MS $=1.19 \mathrm{~min}$; ESI MS $m / z 189[\mathrm{M}+\mathrm{H}]^{+}$.

The residue from above was dissolved in 40 mL of dry THF and cooled to $0{ }^{\circ} \mathrm{C}$ before concurrently adding $\mathrm{Et}_{3} \mathrm{~N}$ ( $2.84 \mathrm{~mL}, 20.4 \mathrm{mmol}$ ) and benzyl chloroformate ( $2.86 \mathrm{~mL}, 20.4 \mathrm{mmol}$ ) dropwise over 20 min . The reaction was warmed to rt and stirred another 3 h . The solvent was removed under vacuum. The residue was dissolved in EtOAc ( 100 mL ), washed with brine ( $3 \times 30 \mathrm{~mL}$ ), dried over $\mathrm{MgSO}_{4}$, and concentrated under vacuum to yield $6.35 \mathrm{~g}(97 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} \mathrm{1:1})=0.54$; ${ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 7.32(\mathrm{~m}, 5 \mathrm{H}), 5.11(\mathrm{~s}, 2 \mathrm{H}), 3.30(\mathrm{~s}, 4 \mathrm{H}), 2.58(\mathrm{~s}, 4 \mathrm{H}), 1.70(\mathrm{~m}, 2 \mathrm{H}), 1.48(\mathrm{~s}, 1 \mathrm{H})$, $1.06(\mathrm{~m}, 6 \mathrm{H}) ;$ LC-MS $=5.25 \mathrm{~min}$; ESI MS m/z $345[\mathrm{M}+\mathrm{Na}]^{+}$.

To a solution of the above intermediate ( $6.35 \mathrm{~g}, 19.7 \mathrm{mmol}$ ) in 20 mL of acetone was added $36 \%$ aqueous $\mathrm{HCl}(20 \mathrm{~mL})$ dropwise at rt . The reaction mixture was stirred for 16 h before removing the solvent under vacuum. The residue was dissolved in EtOAc ( 100 mL ), washed with sat. $\mathrm{NaHCO}_{3}$, brine, dried over $\mathrm{MgSO}_{4}$, and concentrated under vacuum to yield $1.20 \mathrm{~g}(27 \%)$ of a pale yellow oil. LC-MS $=1.19 \mathrm{~min} ;$ ESI MS $m / z 223[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{2}\{2\}$. To a dry roundbottom flask was added 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and $N, N$-diethylethylenediamine ( 10.1 mL , $70.4 \mathrm{mmol})$. To this stirred solution at $-78^{\circ} \mathrm{C}$ was added a solution of benzyl chloroformate ( 1.0 mL , 7.04 mmol ) in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ over 1 h . The reaction was stirred for 1.5 h at $-78^{\circ} \mathrm{C}$ before warming to rt and stirring for another 18 h . The reaction was filtered and the filtrate washed with brine $(3 \times 50 \mathrm{~mL})$, dried over $\mathrm{MgSO}_{4}$, and concentrated under vacuum. The product was purified by column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{MeOH}(19: 1 \rightarrow 3: 2)$, yielding $1.40 \mathrm{~g}(80 \%)$ of a brown oil. TLC $\mathrm{R}_{f}$ $(\mathrm{EtOAc})=0.05 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 7.27-7.33(\mathrm{~m}, 5 \mathrm{H}), 5.11(\mathrm{~s}, 2 \mathrm{H}), 3.32(\mathrm{~m}, 4 \mathrm{H}), 2.59-2.76(\mathrm{~m}$, 4H), 1.00-1.12 (m, 6H); LC-MS = 1.45 min ; ESI MS m/z $251[\mathrm{M}+\mathrm{H}]^{+}$.

4\{1-2,1-4\}. To a solution of the Z- $N, N$-dialkylalkanediamine in $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ was added the Boc-amino acid, EDC $\cdot \mathrm{HCl}$, and DMAP at rt . The reaction was stirred for a period of time before removing the solvent under vacuum. The product was purified by column chromatography on silica gel.
$\mathbf{4}\{1,1\}$. As described using $\mathbf{2}\{1\}(2.00 \mathrm{~g}, 9.01 \mathrm{mmol})$ in 100 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{1\}(1.58 \mathrm{~g}, 9.01 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(3.79 \mathrm{~g}, 19.82 \mathrm{mmol})$, and $\mathrm{DMAP}(0.22 \mathrm{~g}, 1.80 \mathrm{mmol})$ at rt . The reaction was stirred for 16 $h$ and the product was purified by column chromatography on silica gel using EtOAc/hexanes $(1: 3 \rightarrow 1: 0)$, as the gradient, yielding $2.94 \mathrm{~g}(86 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} 1: 1)=0.37 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.26-7.33(\mathrm{~m}, 5 \mathrm{H}), 5.38(\mathrm{~s}, 1 \mathrm{H}), 5.08(\mathrm{~d}, 2 \mathrm{H}), 3.73-3.81(\mathrm{~m}, 2 \mathrm{H}), 3.41-3.54(\mathrm{~m}, 4 \mathrm{H})$, $2.77-2.97(\mathrm{~m}, 6 \mathrm{H}), 1.43(\mathrm{~s}, 9 \mathrm{H}) ;$ LC-MS $=3.49 \mathrm{~min} ;$ ESI MS m/z $380[\mathrm{M}+\mathrm{H}]^{+}$.
$4\{1,2\}$. As described using $2\{1\}(0.33 \mathrm{~g}, 1.50 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{2\}(0.28 \mathrm{~g}, 1.50 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(0.63 \mathrm{~g}, 3.30 \mathrm{mmol})$, and DMAP $(25 \mathrm{mg}, 0.30 \mathrm{mmol})$ at rt . The reaction was stirred for 18.5 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes (1:3 $\rightarrow 1: 0$ ), as the gradient, yielding $0.42 \mathrm{~g}(72 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.54 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right)$ $\delta 7.32-7.33(\mathrm{~m}, 5 \mathrm{H}), 5.39(\mathrm{~s}, 1 \mathrm{H}), 5.05(\mathrm{~m}, 2 \mathrm{H}), 4.52(\mathrm{~m}, 1 \mathrm{H}), 3.22-3.85(\mathrm{~m}, 4 \mathrm{H}), 2.84-3.05(\mathrm{~m}, 6 \mathrm{H})$, $1.40(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~d}, J=6.8 \mathrm{~Hz}, 3 \mathrm{H}) ; \mathrm{LC}-\mathrm{MS}=4.11 \mathrm{~min} ;$ ESI MS $m / z 394[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{4}\{1,3\}$. As described using $\mathbf{2}\{1\}(0.44 \mathrm{~g}, 2.00 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{3\}(0.38 \mathrm{~g}, 2.00 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(0.84 \mathrm{~g}, 4.40 \mathrm{mmol})$, and DMAP $(49 \mathrm{mg}, 0.40 \mathrm{mmol})$ at rt . The reaction was stirred for 12.5 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes $(1: 3 \rightarrow 1: 0)$, as the gradient, yielding $0.59 \mathrm{~g}(75 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} 1: 1)=0.20 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.32(\mathrm{~m}, 5 \mathrm{H}), 5.39(\mathrm{~s}, 1 \mathrm{H}), 5.05(\mathrm{~m}, 2 \mathrm{H}), 4.52(\mathrm{~m}, 1 \mathrm{H}), 3.22-3.84(\mathrm{~m}, 4 \mathrm{H}), 2.84-3.05(\mathrm{~m}$, $6 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H}), 1.22(\mathrm{~d}, 3 \mathrm{H}) ;$ LC-MS $=4.11 \mathrm{~min} ;$ ESI MS m/z $394[\mathrm{M}+\mathrm{H}]^{+}$.

4\{1,4\}. As described using $2\{1\}(0.44 \mathrm{~g}, 2.00 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{4\}(0.50 \mathrm{~g}, 2.00 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(0.84 \mathrm{~g}, 4.40 \mathrm{mmol})$, and DMAP (49 mg, 0.40 mmol$)$ at rt . The reaction was stirred for 13 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes $(1: 3 \rightarrow 1: 0)$, as the gradient, yielding $0.81 \mathrm{~g}(93 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} 1: 1)=0.28 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.32(\mathrm{~m}, 5 \mathrm{H}), 5.02-5.12(\mathrm{~m}, 3 \mathrm{H}), 4.57(\mathrm{~s}, 1 \mathrm{H}), 3.23-3.84(\mathrm{~m}, 4 \mathrm{H}), 2.83-3.08(\mathrm{~m}, 6 \mathrm{H})$, $1.41-1.71(\mathrm{~m}, 3 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H}), 0.88-0.97(\mathrm{~m}, 6 \mathrm{H}) ;$ LC-MS $=6.01 \mathrm{~min} ;$ ESI MS $m / z 436[\mathrm{M}+\mathrm{H}]^{+}$.
$4\{2,1\}$. As described using $2\{2\}(0.70 \mathrm{~g}, 2.80 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{1\}(0.49 \mathrm{~g}, 2.80 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(1.18 \mathrm{~g}, 6.16 \mathrm{mmol})$, and DMAP $(68 \mathrm{mg}, 0.56 \mathrm{mmol})$ at rt . The reaction was stirred for 15 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes (1:3 $\rightarrow 1: 0)$, as the gradient, yielding $1.05 \mathrm{~g}(92 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} 1: 1)=0.34 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.32(\mathrm{~s}, 5 \mathrm{H}), 5.43(\mathrm{~s}, 1 \mathrm{H}), 5.10(\mathrm{~s}, 2 \mathrm{H}), 3.82(\mathrm{~m}, 2 \mathrm{H}), 3.04-3.47(\mathrm{~m}, 8 \mathrm{H}), 1.42(\mathrm{~s}, 9 \mathrm{H})$, $0.98-1.15(\mathrm{~m}, 6 \mathrm{H}) ;$ LC-MS $=5.03 \mathrm{~min} ;$ ESI MS m/z $408[\mathrm{M}+\mathrm{H}]^{+}$.
$4\{2,2\}$. As described using $2\{2\}(0.70 \mathrm{~g}, 2.80 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{2\}(0.53 \mathrm{~g}, 2.80 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(1.18 \mathrm{~g}, 6.16 \mathrm{mmol})$, and DMAP $(68 \mathrm{mg}, 0.56 \mathrm{mmol})$ at rt . The reaction was stirred for 17 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes (1:3 $\rightarrow 1: 0)$, as the gradient, yielding $1.06 \mathrm{~g}(90 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} 1: 1)=0.42 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.32(\mathrm{~s}, 5 \mathrm{H}), 5.33(\mathrm{~s}, 1 \mathrm{H}), 5.10(\mathrm{~s}, 2 \mathrm{H}), 4.52(\mathrm{~s}, 1 \mathrm{H}), 3.19-3.64(\mathrm{~m}, 8 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H})$, $0.97-1.25(\mathrm{~m}, 9 \mathrm{H}) ;$ LC-MS $=4.82 \mathrm{~min} ;$ ESI MS m/z $422[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{4}\{2,3\}$. As described using $\mathbf{2}\{2\}(0.70 \mathrm{~g}, 2.80 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{3\}(0.53 \mathrm{~g}, 2.80 \mathrm{mmol})$, EDC $\cdot \mathrm{HCl}(1.18 \mathrm{~g}, 6.16 \mathrm{mmol})$, and DMAP ( $68 \mathrm{mg}, 0.56 \mathrm{mmol}$ ) at rt. The reaction was stirred for 18 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes ( $1: 3 \rightarrow 1: 0$ ), as the gradient, yielding $1.01 \mathrm{~g}(86 \%)$ of a colorless oil. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{Hex} \mathrm{1:1)})=0.42 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.32(\mathrm{~s}, 5 \mathrm{H}), 5.33(\mathrm{~s}, 1 \mathrm{H}), 5.10(\mathrm{~s}, 2 \mathrm{H}), 4.52(\mathrm{~s}, 1 \mathrm{H}), 3.19-3.64(\mathrm{~m}, 8 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H})$, $0.97-1.25(\mathrm{~m}, 9 \mathrm{H}) ;$ LC-MS $=4.82 \mathrm{~min}$; ESI MS m/z $422[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{4}\{2,4\}$. As described using $\mathbf{2}\{2\}(0.70 \mathrm{~g}, 2.80 \mathrm{mmol})$ in 40 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ with $\mathbf{3}\{4\}(0.70 \mathrm{~g}, 2.80 \mathrm{mmol})$, EDC $\cdot \mathrm{HCl}(1.18 \mathrm{~g}, 6.16 \mathrm{mmol})$, and DMAP ( $68 \mathrm{mg}, 0.56 \mathrm{mmol}$ ) at rt. The reaction was stirred for 18 h and the product was purified by column chromatography on silica gel using EtOAc/hexanes ( $1: 3 \rightarrow 1: 0$ ), as the gradient, yielding $1.10 \mathrm{~g}(85 \%)$ of a colorless oil. $\mathrm{TLC}_{\mathrm{R}}(\mathrm{EtOAc} / \mathrm{Hex} 1: 1)=0.55 ;{ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 7.27-7.33(\mathrm{~m}, 5 \mathrm{H}), 5.10(\mathrm{~m}, 3 \mathrm{H}), 4.56(\mathrm{~s}, 1 \mathrm{H}), 3.25-3.63(\mathrm{~m}, 8 \mathrm{H}), 1.68(\mathrm{~s}, 1 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H})$, $1.23(\mathrm{~m}, 2 \mathrm{H}), 0.89-1.11(\mathrm{~m}, 12 \mathrm{H}) ;$ LC-MS $=6.93 \mathrm{~min}$; ESI MS m/z $464[\mathrm{M}+\mathrm{H}]^{+}$.

5\{1-2,1-4\}. A suspension of one intermediate, $\mathbf{4}\{1-2,1-4\}$, and $5 \% \mathrm{Pd} / \mathrm{C}$ in $\mathrm{CH}_{3} \mathrm{OH}$ was stirred at rt under 1 atm of $\mathrm{H}_{2}$. The reaction was stirred until complete, filtered to remove the $\mathrm{Pd} / \mathrm{C}$, and concentrated under vacuum. The product was used without further purification.
$\mathbf{5}\{1,1\}$. As described using $\mathbf{4}\{1,1\}(2.90 \mathrm{~g}, 7.65 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.40 \mathrm{~g})$ in 120 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 11 h and workup yielded $1.80 \mathrm{~g}(96 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 5.49(\mathrm{~s}, 1 \mathrm{H}), 3.92(\mathrm{q}, J=8.0 \mathrm{~Hz}, 2 \mathrm{H}), 3.49(\mathrm{t}, J=6.4 \mathrm{~Hz}, 1 \mathrm{H}), 3.30(\mathrm{t}, J=6.4 \mathrm{~Hz}, 1 \mathrm{H}), 2.94$ $(\mathrm{d}, J=2.8 \mathrm{~Hz}, 3 \mathrm{H}), 2.72(\mathrm{~m}, 2 \mathrm{H}), 2.41(\mathrm{~d}, J=3.6 \mathrm{~Hz}, 3 \mathrm{H}), 1.42(\mathrm{~s}, 9 \mathrm{H}), 1.28(\mathrm{~s}, 1 \mathrm{H}) ;$ LC-MS $=1.20 \mathrm{~min} ;$ ESI MS m/z $246[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{1,2\}$. As described using $\mathbf{4}\{1,2\}(0.56 \mathrm{~g}, 1.43 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 10.5 h and workup yielded $0.35 \mathrm{~g}(95 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 5.48(\mathrm{~m}, 1 \mathrm{H}), 4.43(\mathrm{~m}, 1 \mathrm{H}), 3.23-3.46(\mathrm{~m}, 2 \mathrm{H}), 2.92(\mathrm{~d}, 3 \mathrm{H}), 2.65(\mathrm{~m}, 2 \mathrm{H}), 2.28(\mathrm{~d}, J=6.8 \mathrm{~Hz}$, $3 \mathrm{H}), 1.72(\mathrm{~s}, 1 \mathrm{H}), 1.27(\mathrm{~s}, 9 \mathrm{H}), 1.15(\mathrm{dd}, J=2.4,6.8 \mathrm{~Hz}, 3 \mathrm{H}) ;$ LC-MS $=1.15 \mathrm{~min}$; ESI MS $m / z 260$ $[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{1,3\}$. As described using $\mathbf{4}\{1,3\}(0.59 \mathrm{~g}, 1.50 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 10.5 h and workup yielded $0.38 \mathrm{~g}(98 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 5.48(\mathrm{~m}, 1 \mathrm{H}), 4.43(\mathrm{~m}, 1 \mathrm{H}), 3.23-3.46(\mathrm{~m}, 2 \mathrm{H}), 2.92(\mathrm{~d}, 3 \mathrm{H}), 2.65(\mathrm{~m}, 2 \mathrm{H}), 2.28(\mathrm{~d}, J=6.8 \mathrm{~Hz}$, $3 \mathrm{H}), 1.72(\mathrm{~s}, 1 \mathrm{H}), 1.27(\mathrm{~s}, 9 \mathrm{H}), 1.15(\mathrm{dd}, J=2.4,6.8 \mathrm{~Hz}, 3 \mathrm{H}) ;$ LC-MS $=1.15 \mathrm{~min}$; ESI MS $m / z 260$ $[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{1,4\}$. As described using $\mathbf{4}\{1,4\}(0.81 \mathrm{~g}, 1.86 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 10.5 h and workup yielded $0.54 \mathrm{~g}(96 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 9.28(\mathrm{~d}, 1 \mathrm{H}), 5.50(\mathrm{~d}, J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 4.49(\mathrm{~m}, 1 \mathrm{H}), 3.62-3.95(\mathrm{~m}, 4 \mathrm{H}), 3.16(\mathrm{~s}, 3 \mathrm{H}), 2.70$ $(\mathrm{s}, 3 \mathrm{H}), 1.67(\mathrm{~m}, 1 \mathrm{H}), 1.41-1.49(\mathrm{~m}, 2 \mathrm{H}), 1.38(\mathrm{~s}, 9 \mathrm{H}), 0.89(\mathrm{q}, J=6.8 \mathrm{~Hz}, 6 \mathrm{H}) ;$ LC-MS = $1.20 \mathrm{~min} ;$ ESI MS m/z $302[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{2,1\}$. As described using $\mathbf{4}\{2,1\}(1.00 \mathrm{~g}, 2.46 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 17.5 h and workup yielded $0.67 \mathrm{~g}(100 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$
$\left(\mathrm{CDCl}_{3}\right) \delta 5.52(\mathrm{~s}, 1 \mathrm{H}), 3.95(\mathrm{~m}, 2 \mathrm{H}), 3.21-3.46(\mathrm{~m}, 4 \mathrm{H}), 2.55-2.78(\mathrm{~m}, 4 \mathrm{H}), 1.42(\mathrm{~s}, 9 \mathrm{H}), 1.26(\mathrm{~s}$, $1 \mathrm{H}), 0.95-1.18(\mathrm{~m}, 6 \mathrm{H}) ;$ LC-MS $=1.11 \mathrm{~min}$; ESI MS $m / z 274[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{2,2\}$. As described using $\mathbf{4}\{2,2\}(1.02 \mathrm{~g}, 2.42 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 17.5 h and workup yielded $0.64 \mathrm{~g}(97 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 5.36(\mathrm{~s}, 1 \mathrm{H}), 4.56(\mathrm{~m}, 1 \mathrm{H}), 3.21-3.55(\mathrm{~m}, 4 \mathrm{H}), 2.61-2.83(\mathrm{~m}, 4 \mathrm{H}), 1.41(\mathrm{~s}, 9 \mathrm{H}), 1.28(\mathrm{~m}$, $3 \mathrm{H}), 1.05-1.21(\mathrm{~m}, 6 \mathrm{H}) ;$ LC-MS $=1.13 \mathrm{~min}$; ESI MS $m / z 288[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{2,3\}$. As described using $\mathbf{4}\{2,3\}(1.00 \mathrm{~g}, 2.38 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt . The reaction was stirred for 17.5 h and workup yielded $0.63 \mathrm{~g}(92 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 5.36(\mathrm{~s}, 1 \mathrm{H}), 4.56(\mathrm{~m}, 1 \mathrm{H}), 3.21-3.55(\mathrm{~m}, 4 \mathrm{H}), 2.61-2.83(\mathrm{~m}, 4 \mathrm{H}), 1.41(\mathrm{~s}, 9 \mathrm{H}), 1.28(\mathrm{~m}$, $3 \mathrm{H}), 1.05-1.21(\mathrm{~m}, 6 \mathrm{H}) ;$ LC-MS $=1.13 \mathrm{~min}$; ESI MS $m / z 288[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{5}\{2,4\}$. As described using $\mathbf{4}\{2,4\}(1.06 \mathrm{~g}, 2.29 \mathrm{mmol})$ and $5 \% \mathrm{Pd} / \mathrm{C}(0.10 \mathrm{~g})$ in 40 mL of $\mathrm{CH}_{3} \mathrm{OH}$ at rt. The reaction was stirred for 17.5 h and workup yielded $0.71 \mathrm{~g}(94 \%)$ of a colorless oil. ${ }^{1} \mathrm{H}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 5.13(\mathrm{~d}, J=9.2 \mathrm{~Hz}, 1 \mathrm{H}), 4.58(\mathrm{q}, J=6.0 \mathrm{~Hz}, 1 \mathrm{H}), 3.18-3.57(\mathrm{~m}, 4 \mathrm{H}), 2.61-2.85(\mathrm{~m}, 4 \mathrm{H})$, $1.70(\mathrm{~m}, 1 \mathrm{H}), 1.50(\mathrm{~m}, 2 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H}), 1.05-1.24(\mathrm{~m}, 6 \mathrm{H}), 0.90(\mathrm{q}, J=6.8 \mathrm{~Hz}, 6 \mathrm{H}) ;$ LC-MS $=1.48 \mathrm{~min} ;$ ESI MS m/z $330[\mathrm{M}+\mathrm{H}]^{+}$.

5,10-dioxo-5H,10H-diimidazo $\left\{1,5-\mathrm{a}: 1^{\prime}, 5{ }^{\prime}-\mathrm{d}\right\}$ pyrazine-1,6-dicarbonyl Amino Acid Esters, $\mathbf{6}\{1-4\}$. Briefly, to a dry round-bottom flask under argon was added dry $\mathrm{CH}_{2} \mathrm{Cl}_{2}$. To this stirred solvent at $-78^{\circ} \mathrm{C}$ were added, in order, the pyrazine diacid chloride (1 equiv.), the amino acid ester hydrochloride salt (2 equiv.), and $\mathrm{N}, \mathrm{N}$-diethylaniline (4 equiv.). The resulting solution was held at $-78{ }^{\circ} \mathrm{C}$ for 30 min before stirring at room temperature. The reaction was washed against water ( $3 \times$ ) and the organic fraction was dried over $\mathrm{MgSO}_{4}$, filtered and concentrated. The residue was suspended in boiling EtOAc, stirred for 15 min and then cooled at $0{ }^{\circ} \mathrm{C}$. The solid product $\mathbf{6}\{1-4\}$ was collected by vacuum filtration and washed with EtOAc. The final product was characterized by ${ }^{1} \mathrm{H}-\mathrm{NMR}$ spectroscopy.

6\{1\}. ${ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 8.64(\mathrm{~s}, 2 \mathrm{H}), 8.59(\mathrm{t}, J=4.8 \mathrm{~Hz}, 2 \mathrm{H}), 4.17(\mathrm{~d}, J=4.8 \mathrm{~Hz}, 2 \mathrm{H}), 1.49(\mathrm{~s}, 18 \mathrm{H})$.
6\{2\}. ${ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 8.68(\mathrm{~d}, J=7.2 \mathrm{~Hz}, 2 \mathrm{H}), 8.63(\mathrm{~s}, 2 \mathrm{H}), 4.70(\mathrm{dt}, J=6.8,7.2 \mathrm{~Hz}, 2 \mathrm{H}), 1.51$ (d, $J=6.8 \mathrm{~Hz}, 6 \mathrm{H}$ ), $1.48(\mathrm{~s}, 18 \mathrm{H})$.

6\{3\}. ${ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 8.68(\mathrm{~d}, J=7.2 \mathrm{~Hz}, 2 \mathrm{H}), 8.63(\mathrm{~s}, 2 \mathrm{H}), 4.70(\mathrm{dt}, J=6.8,7.2 \mathrm{~Hz}, 2 \mathrm{H}), 1.51$ (d, $J=6.8 \mathrm{~Hz}, 6 \mathrm{H}$ ), $1.48(\mathrm{~s}, 18 \mathrm{H})$.

6\{4\}. ${ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 8.63(\mathrm{~s}, 2 \mathrm{H}), 8.50(\mathrm{~d}, J=8.4 \mathrm{~Hz}, 2 \mathrm{H}), 4.76(\mathrm{~m}, 2 \mathrm{H}), 1.75(\mathrm{~m}, 6 \mathrm{H}), 1.47$ ( $\mathrm{s}, 18 \mathrm{H}$ ), 0.97 (d, $J=6.0 \mathrm{~Hz}, 12 \mathrm{H}$ ).

7 $\{1-2,1-4,1-4\}$. To a suspension of one amino acid ester substituted pyrazine, $\mathbf{6}\{1-4\}$ in $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ was added one intermediate, $5\{1-2,1-4\}$ at rt. The reaction was stirred until complete, the solvent removed under vacuum, and the product purified by column chromatography on silica gel.
$7\{1,1,1\}$. As described using $\mathbf{6}\{1\}(0.20 \mathrm{~g}, 0.40 \mathrm{mmol})$ and $\mathbf{5}\{1,1\}(0.25 \mathrm{~g}, 1.00 \mathrm{mmol})$ in 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of

EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 4: 1$ ) yielded $0.25 \mathrm{~g}(63 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 9: 1)=0.25 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.26(\mathrm{~m}, 1 \mathrm{H}), 10.50-10.93(\mathrm{~m}, 1 \mathrm{H})$, $7.58(\mathrm{~d}, J=5.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.56(\mathrm{t}, J=11.2 \mathrm{~Hz}, 1 \mathrm{H}), 3.64-4.19(\mathrm{~m}, 8 \mathrm{H}), 2.85-3.42(\mathrm{~m}, 6 \mathrm{H}), 1.47(\mathrm{~s}, 9 \mathrm{H})$, 1.39 (s, 9H); ${ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 169.0,168.9,168.4,168.3,168.2,168.1,165.9,165.8,165.4,159.7$, $159.5,158.6,155.8,136.5,135.4,134.8,134.6,134.5,134.4,133.8,130.7,129.7,129.3,129.2,129.0$, 81.9, 79.5, 79.3, 52.9, 49.5, 48.6, 47.9, 47.2, 46.7, 46.6, 45.9, 45.4, 42.6, 42.4, 42.3, 41.9, 41.6, 39.0, $38.6,35.9,35.6,35.0,34.5,34.2,34.0,28.3,28.0 ;$ LC-MS $=1.67 \mathrm{~min}$; ESI MS $m / z 497[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{7}\{1,1,2\}$. As described using $\mathbf{6}\{2\}(0.21 \mathrm{~g}, 0.40 \mathrm{mmol})$ and $\mathbf{5}\{1,1\}(0.25 \mathrm{~g}, 1.00 \mathrm{mmol})$ in 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $0.30 \mathrm{~g}(75 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 9: 1)=0.28 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.22(\mathrm{~m}, 1 \mathrm{H}), 10.57-10.96(\mathrm{~m}, 1 \mathrm{H})$, $7.58(\mathrm{~d}, J=7.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.54(\mathrm{~d}, 1 \mathrm{H}), 4.53(\mathrm{~m}, 1 \mathrm{H}), 3.69-4.19(\mathrm{~m}, 6 \mathrm{H}), 2.90-3.42(\mathrm{~m}, 6 \mathrm{H}), 1.55(\mathrm{~m}$, $3 \mathrm{H}), 1.44(\mathrm{~s}, 9 \mathrm{H}), 1.38(\mathrm{~s}, 9 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 171.4,171.3,169.0,168.9,165.8,165.4,159.1$, 159.0, 158.9, 158.8, 155.8, 136.3, 135.3, 134.7, 134.6, 134.5, 134.4, 133.8, 130.9, 130.7, 129.9, 129.4, $129.2,82.0,81.6,79.5,52.9,49.5,49.4,48.6,47.3,46.7,45.5,42.3,38.6,36.0,35.6,35.0,34.6,34.2$, 34.0, 28.3, 28.0, 18.0, 17.8; LC-MS = $1.91 \mathrm{~min} ;$ ESI MS m/z $511[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,1,3\}$. As described using $\mathbf{6}\{3\}(0.21 \mathrm{~g}, 0.40 \mathrm{mmol})$ and $\mathbf{5}\{1,1\}(0.25 \mathrm{~g}, 1.00 \mathrm{mmol})$ in 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $0.29 \mathrm{~g}(70 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 9: 1)=0.28 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.22(\mathrm{~m}, 1 \mathrm{H}), 10.57-10.96(\mathrm{~m}, 1 \mathrm{H})$, 7.58 (d, $J=7.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.54(\mathrm{~d}, 1 \mathrm{H}), 4.53(\mathrm{~m}, 1 \mathrm{H}), 3.69-4.19(\mathrm{~m}, 6 \mathrm{H}), 2.90-3.42(\mathrm{~m}, 6 \mathrm{H}), 1.55(\mathrm{~m}$, $3 \mathrm{H}), 1.44(\mathrm{~s}, 9 \mathrm{H}), 1.38(\mathrm{~s}, 9 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 171.4,171.3,169.0,168.9,165.8,165.4,159.1$, $159.0,158.9,158.8,155.8,136.3,135.3,134.7,134.6,134.5,134.4,133.8,130.9,130.7,129.9,129.4$, $129.2,82.0,81.6,79.5,52.9,49.5,49.4,48.6,47.3,46.7,45.5,42.3,38.6,36.0,35.6,35.0,34.6,34.2$, 34.0, 28.3, 28.0, 18.0, 17.8; LC-MS = $1.91 \mathrm{~min} ;$ ESI MS m/z $511[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,1,4\}$. As described using $\mathbf{6}\{4\}(0.25 \mathrm{~g}, 0.40 \mathrm{mmol})$ and $\mathbf{5}\{1,1\}(0.25 \mathrm{~g}, 1.00 \mathrm{mmol})$ in 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $0.25 \mathrm{~g}(57 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 9: 1)=0.32 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.09(\mathrm{~m}, 1 \mathrm{H}), 10.48-10.88(\mathrm{~m}, 1 \mathrm{H})$, $7.56(\mathrm{~m}, 1 \mathrm{H}), 5.52(\mathrm{~d}, 1 \mathrm{H}), 4.53(\mathrm{~m}, 1 \mathrm{H}), 3.63-4.18(\mathrm{~m}, 6 \mathrm{H}), 2.94-3.44(\mathrm{~m}, 6 \mathrm{H}), 1.65-1.80(\mathrm{~m}, 3 \mathrm{H})$, $1.46(\mathrm{~s}, 9 \mathrm{H}), 1.39(\mathrm{~s}, 9 \mathrm{H}), 0.95(\mathrm{~m}, 6 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 171.4,171.3,171.2,168.9,165.8,165.7$, $165.4,165.3,159.2,158.9,158.2,155.8,136.2,135.0,134.7,134.6,134.4,133.8,130.9,130.7,130.0$, $129.7,129.4,129.3,81.9,81.5,79.5,52.9,52.4,52.3,49.6,48.6,47.3,46.8,45.5,42.3,41.4,41.2$, $41.0,38.8,36.0,35.7,35.0,34.7,34.0,28.4,28.3,28.0,25.0,22.8,22.1,22.0$; LC-MS $=3.88 \mathrm{~min}$; ESI MS $m / z 553[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,2,1\}$. As described using $\mathbf{6}\{1\}(73 \mathrm{mg}, 0.146 \mathrm{mmol})$ and $\mathbf{5}\{1,2\}(83 \mathrm{mg}, 0.320 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $129 \mathrm{mg}(86 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.20 ;$ LC-MS $=2.41 \mathrm{~min} ;$ ESI MS m/z $511[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,2,2\}$. As described using $\mathbf{6}\{2\}(174 \mathrm{mg}, 0.328 \mathrm{mmol})$ and $\mathbf{5}\{1,2\}(170 \mathrm{mg}, 0.656 \mathrm{mmol})$ in 10 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 3.5 h . Column chromatography using a gradient of EtOAc/Hex $(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $295 \mathrm{mg}(86 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 9: 1)=0.58 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.28(\mathrm{~s}, 1 \mathrm{H}), 10.61-10.96(\mathrm{~m}, 1 \mathrm{H})$, $7.58(\mathrm{~d}, J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 5.53(\mathrm{~d}, J=6.0 \mathrm{~Hz}, 1 \mathrm{H}), 4.52(\mathrm{~m}, 2 \mathrm{H}), 3.52-4.13(\mathrm{~m}, 4 \mathrm{H}), 2.97-3.44(\mathrm{~m}, 6 \mathrm{H})$, $1.48(\mathrm{~m}, 3 \mathrm{H}), 1.44(\mathrm{~s}, 9 \mathrm{H}), 1.38(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~m}, 3 \mathrm{H}) ;$ LC-MS $=2.93 \mathrm{~min} ;$ ESI MS $m / z 525[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,2,3\}$. As described using $6\{3\}(77 \mathrm{mg}, 0.146 \mathrm{mmol})$ and $5\{1,2\}(83 \mathrm{mg}, 0.320 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt. The reaction was stirred for 19.5 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $136 \mathrm{mg}(89 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.25 ; \mathrm{LC}-\mathrm{MS}=2.93 \mathrm{~min} ; \mathrm{ESI}$ MS $m / z 525[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,2,4\}$. As described using $\mathbf{6}\{4\}(90 \mathrm{mg}, 0.146 \mathrm{mmol})$ and $5\{1,2\}(83 \mathrm{mg}, 0.320 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt. The reaction was stirred for 19.5 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $140 \mathrm{mg}(85 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.38 ; \mathrm{LC}-\mathrm{MS}=4.29 \mathrm{~min} ; \mathrm{ESI} \mathrm{MS} \mathrm{m} / z 567[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,3,1\}$. As described using $\mathbf{6}\{1\}(84 \mathrm{mg}, 0.167 \mathrm{mmol})$ and $\mathbf{5}\{1,3\}(95 \mathrm{mg}, 0.367 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $57 \mathrm{mg}(34 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.15 ; \mathrm{LC}-\mathrm{MS}=1.60 \mathrm{~min} ; \mathrm{ESI} \mathrm{MS} \mathrm{m} / z 511[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,3,2\}$. As described using $\mathbf{6}\{2\}(89 \mathrm{mg}, 0.167 \mathrm{mmol})$ and $\mathbf{5}\{1,3\}(95 \mathrm{mg}, 0.367 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $47 \mathrm{mg}(27 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.23 ; \mathrm{LC}-\mathrm{MS}=1.98 \mathrm{~min} ; \mathrm{ESI}$ MS m/z $525[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,3,3\}$. As described using $\mathbf{6}\{3\}(89 \mathrm{mg}, 0.167 \mathrm{mmol})$ and $5\{1,3\}(95 \mathrm{mg}, 0.367 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $42 \mathrm{mg}(24 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.23 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.60(\mathrm{~d}, 1 \mathrm{H}), 10.58-10.95(\mathrm{~m}, 1 \mathrm{H}), 7.53(\mathrm{~d}$, $J=4.4 \mathrm{~Hz}, 1 \mathrm{H}), 5.58(\mathrm{t}, J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 4.50(\mathrm{~m}, 2 \mathrm{H}), 3.48-4.00(\mathrm{~m}, 4 \mathrm{H}), 2.93-3.35(\mathrm{~m}, 6 \mathrm{H}), 1.48$ $(\mathrm{m}, 3 \mathrm{H}), 1.39(\mathrm{~s}, 9 \mathrm{H}), 1.31(\mathrm{~s}, 9 \mathrm{H}), 1.16(\mathrm{~m}, 3 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.4,173.2,171.3,171.2$, $165.8,165.7,165.4,165.3,159.0,158.9,155.1,154.9,135.2,134.7,134.6,134.5,133.9,129.6,129.4$, $129.3,129.0,81.4,79.2,79.1,49.8,49.4,49.3,48.4,47.9,46.9,46.5,46.2,46.0,45.4,38.6,35.9,35.8$, $35.6,34.0,29.5,28.2,27.9,19.4,18.4,17.9,17.8 ;$ LC-MS $=1.98 \mathrm{~min} ;$ ESI MS m/z $525[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,3,4\}$. As described using $\mathbf{6}\{4\}(103 \mathrm{mg}, 0.167 \mathrm{mmol})$ and $5\{1,3\}(95 \mathrm{mg}, 0.367 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $51 \mathrm{mg}(45 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.38 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.67(\mathrm{~m}, 1 \mathrm{H}), 10.60-10.89(\mathrm{q}, J=6.8 \mathrm{~Hz}, 1 \mathrm{H})$, $7.54(\mathrm{~d}, J=7.2 \mathrm{~Hz}, 1 \mathrm{H}), 5.58(\mathrm{~m}, 1 \mathrm{H}), 4.50(\mathrm{~m}, 2 \mathrm{H}), 3.49-4.07(\mathrm{~m}, 4 \mathrm{H}), 2.93-3.37(\mathrm{~m}, 6 \mathrm{H}), 1.62-1.76$ $(\mathrm{m}, 3 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H}), 1.34(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~m}, 3 \mathrm{H}), 0.91(\mathrm{t},, J=7.2 \mathrm{~Hz}, 1 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right)$
$\delta 173.4,173.2,171.3,165.9,165.7,165.4,165.3,159.3,159.2,159.1,155.1,155.0,135.1,134.8$, $134.6,134.4,134.0,129.7,129.5,129.1,81.3,79.3,79.2,52.3,52.2,49.9,48.5,47.9,47.0,46.5,46.3$, $46.1,45.8,45.5,41.2,41.1,41.0,38.7,35.9,35.7,34.1,29.5,28.2,27.9,27.7,27.6,24.9,22.8,22.7$, 21.9, 21.8, 19.4, 18.4; LC-MS = $4.24 \mathrm{~min} ;$ ESI MS m/z $567[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,4,1\}$. As described using $\mathbf{6}\{1\}(102 \mathrm{mg}, 0.204 \mathrm{mmol})$ and $\mathbf{5}\{1,4\}(135 \mathrm{mg}, 0.449 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $59 \mathrm{mg}(26 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.30 ; \mathrm{LC}-\mathrm{MS}=3.43 \mathrm{~min}$; ESI MS $m / z 553[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{7}\{1,4,2\}$. As described using $\mathbf{6}\{2\}(108 \mathrm{mg}, 0.204 \mathrm{mmol})$ and $\mathbf{5}\{1,4\}(135 \mathrm{mg}, 0.449 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $69 \mathrm{mg}(30 \%)$ of a white solid. $\operatorname{TLC~R}_{f}(\mathrm{EtOAc})=0.40 ; \mathrm{LC}-\mathrm{MS}=4.35 \mathrm{~min} ;$ ESI MS $m / z 567[\mathrm{M}+\mathrm{H}]^{+}$.

7 \{1,4,3\}. As described using $\mathbf{6}\{3\}(108 \mathrm{mg}, 0.204 \mathrm{mmol})$ and $\mathbf{5}\{1,4\}(135 \mathrm{mg}, 0.449 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19.5 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH (1:19 $\rightarrow 4: 1$ ) yielded $49 \mathrm{mg}(21 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.40 ; \mathrm{LC}-\mathrm{MS}=4.35 \mathrm{~min} ;$ ESI MS $m / z 567[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{1,4,4\}$. No product isolated.
$\mathbf{7}\{2,1,1\}$. As described using $\mathbf{6}\{1\}(139 \mathrm{mg}, 0.277 \mathrm{mmol})$ and $\mathbf{5}\{2,1\}(135 \mathrm{mg}, 0.610 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at r . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH (1:19 $\rightarrow 4: 1$ ) yielded $146 \mathrm{mg}(50 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.41 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.47(\mathrm{~d}, 1 \mathrm{H}), 10.58-10.91(\mathrm{~m}, 1 \mathrm{H}), 7.52(\mathrm{~d}$, $J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 5.61(\mathrm{~s}, 1 \mathrm{H}), 3.63-4.11(\mathrm{~m}, 6 \mathrm{H}), 3.19-3.57(\mathrm{~m}, 6 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H}), 1.34(\mathrm{~s}, 9 \mathrm{H}), 1.01$ $(\mathrm{m}, 6 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 168.5,168.4,168.2,168.1,165.6,164.9,164.8,159.8,159.7,159.6$, $155.7,135.4,134.9,134.7,134.5,134.4,134.2,81.7,79.3,79.1,47.4,46.3,46.0,45.4,45.0,44.7$, $44.6,43.6,43.2,42.9,42.5,42.3,41.9,41.4,41.1,28.2,28.0,27.9,27.7,14.5,14.2,13.8,13.5,12.7$, 12.5; LC-MS = 3.31 min ; ESI MS m/z $525[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,1,2\}$. As described using $\mathbf{6}\{2\}(143 \mathrm{mg}, 0.277 \mathrm{mmol})$ and $\mathbf{5}\{2,1\}(135 \mathrm{mg}, 0.610 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $140 \mathrm{mg}(47 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.46 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.54(\mathrm{~d}, 1 \mathrm{H}), 10.59-10.89(\mathrm{~m}, 1 \mathrm{H}), 7.50(\mathrm{~m}, 1 \mathrm{H})$, $5.62(\mathrm{~s}, 1 \mathrm{H}), 4.45(\mathrm{~m}, 1 \mathrm{H}), 3.19-4.10(\mathrm{~m}, 10 \mathrm{H}), 1.40(\mathrm{~s}, 9 \mathrm{H}), 1.34(\mathrm{~s}, 9 \mathrm{H}), 1.10(\mathrm{~m}, 6 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}$ $\left(\mathrm{CDCl}_{3}\right) \delta 171.3,171.2,168.5,165.7,165.6,165.0,164.9,159.1,159.0,158.9,155.7,135.3,134.9$, $134.7,134.4,134.2,129.6,129.3,129.2,128.8,81.4,81.3,79.3,79.1,49.3,49.2,47.3,46.3,45.9$, $45.5,45.3,45.1,44.7,43.6,43.1,42.8,42.5,42.3,41.9,41.4,41.1,28.1,27.9,27.8,17.9,17.8,17.7$, $14.5,14.3,13.8,12.7,12.5 ;$ LC-MS $=2.69 \mathrm{~min} ;$ ESI MS $m / z 539[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,1,3\}$. As described using $\mathbf{6}\{3\}(143 \mathrm{mg}, 0.277 \mathrm{mmol})$ and $\mathbf{5}\{2,1\}(135 \mathrm{mg}, 0.610 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of

EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 4: 1$ ) yielded $170 \mathrm{mg}(57 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.46 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.58(\mathrm{~d}, 1 \mathrm{H}), 10.57-10.87(\mathrm{~m}, 1 \mathrm{H}), 7.50(\mathrm{~d}$, $J=9.2 \mathrm{~Hz}, 1 \mathrm{H}), 5.63(\mathrm{~s}, 1 \mathrm{H}), 4.41(\mathrm{~m}, 1 \mathrm{H}), 3.18-4.09(\mathrm{~m}, 10 \mathrm{H}), 1.37(\mathrm{~s}, 9 \mathrm{H}), 1.32(\mathrm{~s}, 9 \mathrm{H}), 1.22(\mathrm{~m}$, $6 \mathrm{H}) ;{ }^{13} \mathrm{C}$-NMR $\left(\mathrm{CDCl}_{3}\right) \delta 171.4,171.3,168.6,168.5,165.8,165.7,165.1,165.0,159.2,159.1,159.0$, $155.9,155.8,135.4,135.0,134.8,134.5,134.3,129.7,129.4,129.2,128.9,81.4,79.4,79.2,49.4,49.3$, $47.4,46.3,46.0,45.5,45.4,45.2,44.8,43.7,43.2,42.8,42.6,42.4,42.0,41.5,41.2,29.5,28.2,27.9$, $27.7,18.0,17.9,17.8,14.6,14.4,13.9,12.8,12.6 ;$ LC-MS $=2.70 \mathrm{~min} ;$ ESI MS $m / z 539[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,1,4\}$. No product isolated.
$7\{2,2,1\}$. As described using $\mathbf{6}\{1\}(127 \mathrm{mg}, 0.253 \mathrm{mmol})$ and $\mathbf{5}\{2,2\}(160 \mathrm{mg}, 0.557 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $135 \mathrm{mg}(50 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.49 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.52(\mathrm{t}, 1 \mathrm{H}), 10.58-10.91(\mathrm{~m}, 1 \mathrm{H}), 7.51(\mathrm{~d}$, $J=7.2 \mathrm{~Hz}, 1 \mathrm{H}), 5.58(\mathrm{q}, J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 4.50(\mathrm{~m}, 1 \mathrm{H}), 4.01(\mathrm{~d}, J=8.4 \mathrm{~Hz}, 2 \mathrm{H}), 3.17-3.88(\mathrm{~m}, 8 \mathrm{H})$, $1.38(\mathrm{~s}, 9 \mathrm{H}), 1.31(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~m}, 9 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.2,173.1,172.9,168.2,168.1,165.6$, $165.5,164.9,164.8,159.8,159.7,155.0,154.9,135.2,134.9,134.7,134.4,134.3,129.4,129.3,129.0$, $128.7,81.7,81.6,79.2,79.0,47.8,46.4,46.0,45.9,45.7,45.4,45.3,44.9,44.6,44.2,43.6,43.3,43.2$, 43.0, 42.8, 42.3, 41.6, 41.1, 28.2, 28.0, 27.9, 27.8, 19.3, 19.2, 18.9, 14.4, 14.3, 14.0, 12.6, 12.5; LC-MS $=2.43 \mathrm{~min} ;$ ESI MS $m / z 539[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,2,2\}$. As described using $\mathbf{6}\{2\}(131 \mathrm{mg}, 0.253 \mathrm{mmol})$ and $\mathbf{5}\{2,2\}(160 \mathrm{mg}, 0.557 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $140 \mathrm{mg}(50 \%)$ of a white solid. $\mathrm{TLC}_{f}(\mathrm{EtOAc})=0.48 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.57(\mathrm{~d}, 1 \mathrm{H}), 10.62-10.88(\mathrm{~m}, 1 \mathrm{H}), 7.51(\mathrm{~d}$, $J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 5.61(\mathrm{~m}, 1 \mathrm{H}), 4.46(\mathrm{~m}, 2 \mathrm{H}), 3.19-3.97(\mathrm{~m}, 8 \mathrm{H}), 1.39(\mathrm{~s}, 9 \mathrm{H}), 1.32(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~m}$, 12H); ${ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.2,173.0,171.3,171.2,165.7,165.6,165.0,164.9,159.1,158.9,155.1$, $155.0,135.0,134.9,134.7,134.4,129.5,129.3,128.8,81.4,81.3,81.2,79.2,79.0,49.4,49.3,47.8$, $46.5,46.3,46.0,45.8,45.5,45.3,45.0,44.6,44.2,43.6,43.3,43.2,43.1,42.9,41.6,41.1,28.2,27.8$, 19.3, 19.2, 17.9, 17.8, 17.7, 14.4, 14.3, 12.7, 12.5; LC-MS = $3.22 \mathrm{~min} ;$ ESI MS $m / z 553[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{7}\{2,2,3\}$. As described using $\mathbf{6}\{3\}(131 \mathrm{mg}, 0.253 \mathrm{mmol})$ and $\mathbf{5}\{2,2\}(160 \mathrm{mg}, 0.557 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $163 \mathrm{mg}(61 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.46 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.58(\mathrm{t}, 1 \mathrm{H}), 10.61-10.90(\mathrm{~m}, 1 \mathrm{H}), 7.50(\mathrm{~d}$, $J=7.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.54(\mathrm{~d}, 1 \mathrm{H}), 4.43(\mathrm{~m}, 2 \mathrm{H}), 3.17-3.81(\mathrm{~m}, 8 \mathrm{H}), 1.38(\mathrm{~s}, 9 \mathrm{H}), 1.32(\mathrm{~s}, 9 \mathrm{H}), 1.20(\mathrm{~m}$, 12H); ${ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.1,172.9,171.3,171.2,165.7,165.5,165.0,164.9,159.1,158.9,155.0$, $154.9,135.1,134.9,134.6,134.4,129.5,129.2,129.1,128.8,81.3,79.2,79.0,49.3,49.2,47.8,46.3$, $46.0,45.8,45.5,45.3,44.9,44.6,44.1,43.6,43.3,43.1,42.9,42.8,41.5,41.1,28.2,27.8,27.6,19.3$, $19.2,17.9,17.8,17.7,14.4,14.3,12.7,12.6,12.5 ;$ LC-MS $=4.37 \mathrm{~min} ;$ ESI MS $m / z 553[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,2,4\}$. No product isolated.
$7\{2,3,1\}$. As described using $\mathbf{6}\{1\}(126 \mathrm{mg}, 0.250 \mathrm{mmol})$ and $\mathbf{5}\{2,3\}(158 \mathrm{mg}, 0.549 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at r . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $138 \mathrm{mg}(51 \%)$ of a white solid. $\operatorname{TLC~R~}_{f}(\mathrm{EtOAc})=0.49 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.50(\mathrm{t}, 1 \mathrm{H}), 10.61-10.91(\mathrm{~m}, 1 \mathrm{H}), 7.51(\mathrm{t}, J=6.8 \mathrm{~Hz}$, $1 \mathrm{H}), 5.58(\mathrm{q}, J=8.0 \mathrm{~Hz}, 1 \mathrm{H}), 4.51(\mathrm{~m}, 1 \mathrm{H}), 4.02(\mathrm{~d}, J=5.2 \mathrm{~Hz}, 2 \mathrm{H}), 3.16-3.89(\mathrm{~m}, 8 \mathrm{H}), 1.39(\mathrm{~s}, 9 \mathrm{H})$, $1.32(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~m}, 9 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.2,173.1,172.9,168.3,168.2,168.1,165.7,165.5$, $165.0,164.8,159.8,159.7,155.0,135.2,134.9,134.7,134.4,129.5,129.3,129.1,128.7,81.7,81.6$, $79.3,79.2,79.1,47.9,46.4,46.0,45.7,45.5,45.3,44.9,44.6,44.2,43.6,43.3,43.2,43.1,42.9,42.3$, $41.6,41.1,28.2,27.9,19.3,19.2,14.4,14.3,12.7,12.5 ;$ LC-MS = 2.43 min ; ESI MS $m / z 539[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{7}\{2,3,2\}$. As described using $\mathbf{6}\{2\}(129 \mathrm{mg}, 0.250 \mathrm{mmol})$ and $\mathbf{5}\{2,3\}(158 \mathrm{mg}, 0.549 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at r . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $150 \mathrm{mg}(55 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.48 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.57(\mathrm{t}, 1 \mathrm{H}), 10.61-10.90(\mathrm{~m}, 1 \mathrm{H}), 7.51(\mathrm{~d}$, $J=7.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.53(\mathrm{~d}, 1 \mathrm{H}), 4.46(\mathrm{~m}, 2 \mathrm{H}), 3.21-3.83(\mathrm{~m}, 8 \mathrm{H}), 1.38(\mathrm{~s}, 9 \mathrm{H}), 1.32(\mathrm{~s}, 9 \mathrm{H}), 1.20(\mathrm{~m}$, $12 \mathrm{H}) ;{ }^{13} \mathrm{C}$-NMR $\left(\mathrm{CDCl}_{3}\right) \delta 173.1,172.9,171.3,171.2,165.7,165.6,165.0,164.9,159.1,159.0,155.0$, $135.2,135.0,134.9,134.6,134.4,129.5,129.2,129.1,128.8,81.3,79.2,79.0,49.4,49.3,49.2,47.8$, $46.3,46.0,45.8,45.5,45.3,45.0,44.6,44.1,43.6,43.3,43.1,42.9,41.5,41.1,28.2,27.8,27.7,19.3$, $19.2,17.9,17.8,14.4,14.3,12.7,12.5 ;$ LC-MS $=3.19 \mathrm{~min} ;$ ESI MS $m / z 553[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{7}\{2,3,3\}$. As described using $\mathbf{6}\{3\}(129 \mathrm{mg}, 0.250 \mathrm{mmol})$ and $\mathbf{5}\{2,3\}(158 \mathrm{mg}, 0.549 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $177 \mathrm{mg}(64 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.46 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.62(\mathrm{t}, 1 \mathrm{H}), 10.61-10.86(\mathrm{~m}, 1 \mathrm{H}), 7.50(\mathrm{~d}$, $J=7.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.61(\mathrm{~d}, 1 \mathrm{H}), 4.43(\mathrm{~m}, 2 \mathrm{H}), 3.19-3.86(\mathrm{~m}, 8 \mathrm{H}), 1.37(\mathrm{~s}, 9 \mathrm{H}), 1.30(\mathrm{~s}, 9 \mathrm{H}), 1.19(\mathrm{~m}$, 12H); ${ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.2,173.0,171.3,171.2,165.7,165.5,165.0,164.9,159.1,159.0,158.9$, $155.0,135.1,134.9,134.6,134.5,134.3,129.5,129.2,128.8,81.3,81.2,79.2,79.0,49.3,49.2,47.8$, $46.4,46.3,46.0,45.8,45.5,45.3,45.0,44.6,44.2,43.6,43.3,43.1,42.8,41.6,41.1,29.4,28.1,27.8$, $19.2,19.1,18.9,17.8,17.7,14.4,14.3,14.2,12.6,12.5 ;$ LC-MS $=3.17 \mathrm{~min} ;$ ESI MS $m / z 553[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,3,4\}$. No product isolated.
$7\{2,4,1\}$. As described using $\mathbf{6}\{1\}(122 \mathrm{mg}, 0.242 \mathrm{mmol})$ and $\mathbf{5}\{2,4\}(175 \mathrm{mg}, 0.532 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at r . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $143 \mathrm{mg}(51 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.59 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.55(\mathrm{~m}, 1 \mathrm{H}), 10.62-10.94(\mathrm{~m}, 1 \mathrm{H}), 7.52(\mathrm{~d}$, $J=6.4 \mathrm{~Hz}, 1 \mathrm{H}), 5.39(\mathrm{~m}, 1 \mathrm{H}), 4.52(\mathrm{~m}, 1 \mathrm{H}), 4.03(\mathrm{~m}, 2 \mathrm{H}), 3.16-3.89(\mathrm{~m}, 8 \mathrm{H}), 1.47-1.65(\mathrm{~m}, 3 \mathrm{H}), 1.40$ (s, 9H), $1.32(\mathrm{~s}, 9 \mathrm{H}), 1.21(\mathrm{~m}, 6 \mathrm{H}), 0.86(\mathrm{~m}, 6 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.4,173.3,173.1,172.8$, $168.2,168.1,165.6,165.5,165.0,164.8,159.8,155.5,135.0,134.9,134.7,134.6,134.4,129.4,129.3$, $129.0,128.7,81.7,81.6,79.2,79.1,79.0,48.6,48.0,46.4,45.8,45.5,45.4,45.0,44.7,44.2,43.7,43.3$, 43.1, 42.9, 42.7, 42.4, 41.7, 40.9, 28.2, 28.0, 27.9, 24.5, 23.3, 21.8, 21.6, 14.5, 14.4, 12.7, 12.6; LC-MS $=5.12 \mathrm{~min}$; ESI MS $m / z 581[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,4,2\}$. As described using $\mathbf{6}\{2\}(125 \mathrm{mg}, 0.242 \mathrm{mmol})$ and $\mathbf{5}\{2,4\}(175 \mathrm{mg}, 0.532 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $53 \mathrm{mg}(18 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.61 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.31(\mathrm{~m}, 1 \mathrm{H}), 10.70-10.92(\mathrm{~m}, 1 \mathrm{H}), 7.55(\mathrm{~d}$, $J=6.8 \mathrm{~Hz}, 1 \mathrm{H}), 5.27(\mathrm{~m}, 1 \mathrm{H}), 4.49(\mathrm{~m}, 2 \mathrm{H}), 3.21-3.92(\mathrm{~m}, 8 \mathrm{H}), 1.47-1.69(\mathrm{~m}, 3 \mathrm{H}), 1.44(\mathrm{~s}, 9 \mathrm{H}), 1.37$ $(\mathrm{s}, 9 \mathrm{H}), 1.23(\mathrm{~m}, 9 \mathrm{H}), 0.86(\mathrm{~m}, 6 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.4,173.3,173.1,172.9,171.4,171.3$, $165.6,165.5,165.1,164.9,159.2,159.2,159.1,155.6,135.1,135.0,134.8,134.6,134.6,134.5,134.3$, $129.6,129.4,129.3,129.0,81.5,81.4,79.4,79.3,79.2,49.5,49.4,48.6,48.1,46.5,45.9,45.7,45.5$, 45.2, 44.8, 44.4, 43.8, 43.4, 43.1, 42.9, 42.7, 41.8, 41.0, 28.3, 28.0, 24.6, 23.4, 21.9, 21.7, 18.0, 17.9, $17.8,14.5,14.4,12.8,12.7 ;$ LC-MS $=5.78 \mathrm{~min} ;$ ESI MS $m / z 595[\mathrm{M}+\mathrm{H}]^{+}$.
$7\{2,4,3\}$. As described using $\mathbf{6}\{3\}(125 \mathrm{mg}, 0.242 \mathrm{mmol})$ and $\mathbf{5}\{2,4\}(175 \mathrm{mg}, 0.532 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 4: 1)$ yielded $169 \mathrm{mg}(58 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc})=0.54 ;{ }^{1} \mathrm{H}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 12.64(\mathrm{~m}, 1 \mathrm{H}), 10.62-10.86(\mathrm{q}, J=6.8 \mathrm{~Hz}, 1 \mathrm{H})$, $7.55(\mathrm{~d}, J=9.6 \mathrm{~Hz}, 1 \mathrm{H}), 5.40(\mathrm{~m}, 1 \mathrm{H}), 4.46(\mathrm{~m}, 2 \mathrm{H}), 3.34-3.81(\mathrm{~m}, 8 \mathrm{H}), 1.40-1.65(\mathrm{~m}, 3 \mathrm{H}), 1.38(\mathrm{~s}$, $9 \mathrm{H}), 1.30(\mathrm{~s}, 9 \mathrm{H}), 1.16(\mathrm{~m}, 9 \mathrm{H}), 0.85(\mathrm{~m}, 6 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.4,173.3,173.0,172.9,171.3$, $171.2,165.6,165.5,165.1,164.9,159.1,159.0,155.5,135.0,134.9,134.7,134.6,134.4,129.4,129.2$, $129.0,128.8,81.3,81.2,79.1,79.0,49.4,49.2,48.5,48.0,46.4,45.8,45.5,45.3,45.0,44.6,44.1,43.7$, $43.3,43.2,42.9,42.6,41.6,40.9,28.1,27.9,27.7,24.5,23.2,21.8,21.7,21.5,17.8,17.7,14.4,14.3$, $12.7,12.6,12.5 ;$ LC-MS $=5.81 \mathrm{~min} ;$ ESI MS $m / z 595[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{7}\{2,4,4\}$. As described using $\mathbf{6}\{4\}(135 \mathrm{mg}, 0.242 \mathrm{mmol})$ and $\mathbf{5}\{2,4\}(175 \mathrm{mg}, 0.532 \mathrm{mmol})$ in 4 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ at rt . The reaction was stirred for 19 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 4: 1)$ yielded $142 \mathrm{mg}(46 \%)$ of a white solid. TLC $\mathrm{R}_{f}(\mathrm{EtOAc})=0.61 ;{ }^{1} \mathrm{H}-\mathrm{NMsR}\left(\mathrm{CDCl}_{3}\right) \delta 12.64(\mathrm{~m}, 1 \mathrm{H}), 10.67-10.86(\mathrm{~m}, 1 \mathrm{H}), 7.52(\mathrm{~d}$, $J=7.2 \mathrm{~Hz}, 1 \mathrm{H}), 5.37(\mathrm{~m}, 1 \mathrm{H}), 4.47(\mathrm{~m}, 2 \mathrm{H}), 3.36-3.88(\mathrm{~m}, 8 \mathrm{H}), 1.46-1.76(\mathrm{~m}, 6 \mathrm{H}), 1.39(\mathrm{~s}, 9 \mathrm{H}), 1.33$ $(\mathrm{s}, 9 \mathrm{H}), 1.18(\mathrm{~m}, 6 \mathrm{H}), 0.87(\mathrm{~m}, 12 \mathrm{H}) ;{ }^{13} \mathrm{C}-\mathrm{NMR}\left(\mathrm{CDCl}_{3}\right) \delta 173.4,173.3,173.1,172.9,171.3,171.2$, $165.6,165.1,164.9,159.4,159.3,159.2,155.6,155.5,135.0,134.7,134.4,129.5,129.3,129.2,128.9$, 81.3, 81.2, 79.2, 79.1, 52.3, 52.2, 48.6, 47.9, 46.6, 46.4, 45.9, 45.6, 45.5, 45.2, 44.8, 44.4, 43.8, 43.4, $43.2,42.9,42.7,41.8,41.1,41.0,40.9,29.5,28.2,28.1,27.9,24.9,24.6,23.3,22.8,22.7,21.9,21.8$, $21.6,14.5,14.4,12.8,12.7,12.5 ;$ LC-MS $=7.56 \mathrm{~min} ;$ ESI MS m/z $637[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1-2,1-4,1-4\}$. To a solution of one intermediate, $7\{1-2,1-4,1-4\}$ in $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ was added trifluoroacetic acid at rt . The reaction was stirred until complete and the solvent removed under vacuum. The residue was taken up in aqueous HCl and lyophilized to dryness, yielding a material that was used without further purification.
$\mathbf{8}\{1,1,1\}$. As described using $7\{1,1,1\}$ ( $210 \mathrm{mg}, 0.423 \mathrm{mmol}$ ), 5 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 1 mL of TFA. The reaction was stirred for $13 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.14 \mathrm{~min}$; ESI MS $m / z 341[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,1,2\}$. As described using $7\{1,1,2\}$ ( $275 \mathrm{mg}, 0.539 \mathrm{mmol}$ ), 5 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 1 mL of TFA. The reaction was stirred for $13 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.14 \mathrm{~min}$; ESI MS $m / z 355[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,1,3\}$. As described using $7\{1,1,3\}$ ( $260 \mathrm{mg}, 0.510 \mathrm{mmol}$ ), 5 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 1 mL of TFA. The reaction was stirred for $13 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.14 \mathrm{~min}$; ESI MS $m / z 355[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,1,4\}$. As described using $7\{1,1,4\}$ ( $238 \mathrm{mg}, 0.431 \mathrm{mmol}$ ), 5 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 1 mL of TFA. The reaction was stirred for $13.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.09 \mathrm{~min}$; ESI MS $m / z 397[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,2,1\}$. As described using $7\{1,2,1\}$ ( $129 \mathrm{mg}, 0.253 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.12 \mathrm{~min}$; ESI MS $m / z 355[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,2,2\}$. As described using $7\{1,2,2\}(295 \mathrm{mg}, 0.563 \mathrm{mmol}), 10 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 1.5 mL of TFA. The reaction was stirred for $10.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.08 \mathrm{~min}$; ESI MS $m / z 369[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,2,3\}$. As described using $7\{1,2,3\}$ ( $136 \mathrm{mg}, 0.260 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.10 \mathrm{~min}$; ESI MS $m / z 369[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,2,4\}$. As described using $7\{1,2,4\}(140 \mathrm{mg}, 0.247 \mathrm{mmol}), 2 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.10 \mathrm{~min}$; ESI MS $m / z 411[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,3,1\}$. As described using $7\{1,3,1\}(57 \mathrm{mg}, 0.112 \mathrm{mmol}), 2 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.28 \mathrm{~min}$; ESI MS $m / z 355[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,3,2\}$. As described using $7\{1,3,2\}(47 \mathrm{mg}, 0.090 \mathrm{mmol}), 2 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.09 \mathrm{~min}$; ESI MS $m / z 369[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,3,3\}$. As described using $7\{1,3,3\}$ ( $42 \mathrm{mg}, 0.080 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.12 \mathrm{~min}$; ESI MS $m / z 369[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,3,4\}$. As described using $7\{1,3,4\}(51 \mathrm{mg}, 0.090 \mathrm{mmol}), 2 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.13 \mathrm{~min}$; ESI MS $m / z 411[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,4,1\}$. As described using $7\{1,4,1\}(59 \mathrm{mg}, 0.107 \mathrm{mmol}), 2 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.31 \mathrm{~min}$; ESI MS m/z $397[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,4,2\}$. As described using $7\{1,4,2\}$ ( $69 \mathrm{mg}, 0.122 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.11 \mathrm{~min}$; ESI MS $m / z 411[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,4,3\}$. As described using $7\{1,4,3\}$ ( $49 \mathrm{mg}, 0.087 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.10 \mathrm{~min}$; ESI MS $m / z 411[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{1,4,4\}$. No starting material available.
$\mathbf{8}\{2,1,1\}$. As described using $7\{2,1,1\}$ ( $146 \mathrm{mg}, 0.279 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.11 \mathrm{~min}$; ESI MS $m / z 369[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,1,2\}$. As described using $7\{2,1,2\}$ ( $140 \mathrm{mg}, 0.260 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.08 \mathrm{~min}$; ESI MS $m / z 383[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,1,3\}$. As described using $7\{2,1,3\}$ ( $170 \mathrm{mg}, 0.316 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.10 \mathrm{~min}$; ESI MS $m / z 383[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,1,4\}$. No starting material available.
$\mathbf{8}\{2,2,1\}$. As described using $7\{2,2,1\}$ ( $135 \mathrm{mg}, 0.251 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.09 \mathrm{~min}$; ESI MS $m / z 383[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,2,2\}$. As described using $7\{2,2,2\}$ ( $140 \mathrm{mg}, 0.254 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.10 \mathrm{~min}$; ESI MS $m / z 397[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,2,3\}$. As described using $7\{2,2,3\}$ ( $163 \mathrm{mg}, 0.295 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.09 \mathrm{~min}$; ESI MS $m / z 397[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,2,4\}$. No starting material available.
$\mathbf{8}\{2,3,1\}$. As described using $7\{2,3,1\}$ ( $138 \mathrm{mg}, 0.257 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.05 \mathrm{~min}$; ESI MS $m / z 383[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,3,2\}$. As described using $7\{2,3,2\}$ ( $150 \mathrm{mg}, 0.272 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.13 \mathrm{~min}$; ESI MS $m / z 397[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,3,3\}$. As described using $7\{2,3,3\}$ ( $177 \mathrm{mg}, 0.321 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.08 \mathrm{~min}$; ESI MS $m / z 397[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,3,4\}$. No starting material available.
$\mathbf{8}\{2,4,1\}$. As described using $7\{2,4,1\}$ ( $143 \mathrm{mg}, 0.247 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.10 \mathrm{~min}$; ESI MS $m / z 425[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,4,2\}$. As described using $7\{2,4,2\}$ ( $53 \mathrm{mg}, 0.089 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for 17.5 h . LC-MS $=1.12 \mathrm{~min}$; ESI MS $m / z 439[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,4,3\}$. As described using $7\{2,4,3\}$ ( $169 \mathrm{mg}, 0.285 \mathrm{mmol}$ ), 2 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for $17.5 \mathrm{~h} . \mathrm{LC}-\mathrm{MS}=1.08 \mathrm{~min}$; ESI MS $m / z 439[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{8}\{2,4,4\}$. As described using $7\{2,4,4\}(142 \mathrm{mg}, 0.223 \mathrm{mmol}), 2 \mathrm{~mL}$ of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ and 0.5 mL of TFA. The reaction was stirred for 17.5 h . LC-MS $=1.08 \mathrm{~min}$; ESI MS $m / z 481[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1-2,1-4,1-4\}$. To 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ in a dry roundbottom flask was added dropwise over 1 h a solution of one intermediate, $\mathbf{8}\{1-2,1-4,1-4\}$ (1 equiv.) in 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$ concurrent with the dropwise addition of a solution containing $\mathrm{EDC} \cdot \mathrm{HCl}$ ( 2.2 equiv.) and DMAP ( 0.2 equiv.) in 20 mL of $\mathrm{CH}_{2} \mathrm{Cl}_{2}$. The resulting solution was stirred for a period of time before removing the solvent under vacuum and purifying the macrocycle by column chromatography on silica gel.
$\mathbf{9}\{1,1,1\}$. As described using $\mathbf{8}\{1,1,1\}$ ( $72 \mathrm{mg}, 0.210 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(89 \mathrm{mg}, 0.466 \mathrm{mmol})$, and DMAP ( $5 \mathrm{mg}, 0.042 \mathrm{mmol}$ ). The reaction was stirred for 10.5 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $32 \mathrm{mg}(47 \%)$ of a white solid. $\mathrm{TLC}_{\mathrm{R}}(\mathrm{EtOAc} / \mathrm{MeOH} 1: 1)=0.25$; LC-MS $=1.19 \mathrm{~min}$; ESI MS $m / z 323[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,1,2\}$. As described using $\mathbf{8}\{1,1,2\}(95 \mathrm{mg}, 0.270 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(113 \mathrm{mg}, 0.593 \mathrm{mmol})$, and DMAP ( $7 \mathrm{mg}, 0.054 \mathrm{mmol}$ ). The reaction was stirred for 21 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 3: 2)$ yielded $32 \mathrm{mg}(47 \%)$ of a white solid. $\operatorname{TLC} \mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 1: 1)=0.35 ; \mathrm{LC}-\mathrm{MS}=1.24 \mathrm{~min}$; ESI MS $m / z 337[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,1,3\}$. As described using $\mathbf{8}\{1,1,3\}(90 \mathrm{mg}, 0.254 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(107 \mathrm{mg}, 0.559 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.051 \mathrm{mmol}$ ). The reaction was stirred for 18 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 3: 2)$ yielded $32 \mathrm{mg}(47 \%)$ of a white solid. $\operatorname{TLC} \operatorname{R} f(E t O A c / M e O H 1: 1)=0.30 ;$ LC-MS $=1.24 \mathrm{~min}$; ESI MS $m / z 337[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,1,4\}$. As described using $\mathbf{8}\{1,1,4\}$ ( $85 \mathrm{mg}, 0.216 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(91 \mathrm{mg}, 0.474 \mathrm{mmol})$, and DMAP ( $5 \mathrm{mg}, 0.043 \mathrm{mmol}$ ). The reaction was stirred for 17.5 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $32 \mathrm{mg}(47 \%)$ of a white solid. $\mathrm{TLC} \mathrm{R}_{f}(\mathrm{EtOAc} / \mathrm{MeOH} 1: 1)=0.40 ; \mathrm{LC}-\mathrm{MS}=1.43 \mathrm{~min} ;$ ESI MS $m / z 379[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,2,1\}$. As described using $\mathbf{8}\{1,2,1\}(90 \mathrm{mg}, 0.253 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(107 \mathrm{mg}, 0.557 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.051 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{1,2,2\}$. As described using $\mathbf{8}\{1,2,2\}(227 \mathrm{mg}, 0.563 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(192 \mathrm{mg}, 1.24 \mathrm{mmol})$, and DMAP ( $14 \mathrm{mg}, 0.113 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $11 \mathrm{mg}(32 \%)$. LC-MS $=1.19 \mathrm{~min} ;$ ESI MS $m / z 351[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,2,3\}$. As described using $\mathbf{8}\{1,2,3\}$ ( $105 \mathrm{mg}, 0.260 \mathrm{mmol}$ ), EDC $\cdot \mathrm{HCl}(89 \mathrm{mg}, 0.572 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.052 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 3: 2)$ yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{1,2,4\}$. As described using $\mathbf{8}\{1,2,4\}(110 \mathrm{mg}, 0.247 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(84 \mathrm{mg}, 0.543 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.049 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH $(1: 19 \rightarrow 3: 2)$ yielded $11 \mathrm{mg}(12 \%)$. LC-MS $=1.47 \mathrm{~min} ;$ ESI MS $m / z 393[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,3,1\}$. As described using $\mathbf{8}\{1,3,1\}(44 \mathrm{mg}, 0.112 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(38 \mathrm{mg}, 0.246 \mathrm{mmol})$, and DMAP ( $2 \mathrm{mg}, 0.018 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{1,3,2\}$. As described using $\mathbf{8}\{1,3,2\}$ ( $36 \mathrm{mg}, 0.090 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}$ ( $31 \mathrm{mg}, 0.198 \mathrm{mmol}$ ), and DMAP ( $2 \mathrm{mg}, 0.018 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex $(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded $7 \mathrm{mg}(22 \%)$. LC-MS $=1.56 \mathrm{~min} ;$ ESI MS $m / z 351[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,3,3\}$. As described using $\mathbf{8}\{1,3,3\}$ ( $32 \mathrm{mg}, 0.080 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(27 \mathrm{mg}, 0.176 \mathrm{mmol})$, and DMAP ( $2 \mathrm{mg}, 0.016 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{1,3,4\}$. As described using $\mathbf{8}\{1,3,4\}(40 \mathrm{mg}, 0.090 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(31 \mathrm{mg}, 0.198 \mathrm{mmol})$, and DMAP ( $2 \mathrm{mg}, 0.018 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded $4 \mathrm{mg}(11 \%)$. LC-MS $=1.43 \mathrm{~min} ;$ ESI MS $m / z 393[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,4,1\}$. As described using $\mathbf{8}\{1,4,1\}$ ( $46 \mathrm{mg}, 0.107 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(37 \mathrm{mg}, 0.235 \mathrm{mmol})$, and DMAP ( $3 \mathrm{mg}, 0.021 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{1,4,2\}$. As described using $\mathbf{8}\{1,4,2\}$ ( $55 \mathrm{mg}, 0.122 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(42 \mathrm{mg}, 0.268 \mathrm{mmol})$, and DMAP ( $3 \mathrm{mg}, 0.024 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded $7 \mathrm{mg}(14 \%)$. LC-MS $=1.43 \mathrm{~min} ;$ ESI MS $m / z 393[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,4,3\}$. As described using $\mathbf{8}\{1,4,3\}$ ( $39 \mathrm{mg}, 0.087 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(30 \mathrm{mg}, 0.191 \mathrm{mmol})$, and DMAP ( $2 \mathrm{mg}, 0.017 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $13 \mathrm{mg}(37 \%)$. LC-MS $=1.43 \mathrm{~min} ;$ ESI MS $m / z 393[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{1,4,4\}$. No starting material available.
$\mathbf{9}\{2,1,1\}$. As described using $\mathbf{8}\{2,1,1\}(113 \mathrm{mg}, 0.279 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(95 \mathrm{mg}, 0.614 \mathrm{mmol})$, and DMAP $(7 \mathrm{mg}, 0.056 \mathrm{mmol})$. The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{2,1,2\}$. As described using $\mathbf{8}\{2,1,2\}(109 \mathrm{mg}, 0.260 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(89 \mathrm{mg}, 0.572 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.052 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $9 \mathrm{mg}(9 \%)$. LC-MS $=1.34 \mathrm{~min} ;$ ESI MS $m / z 365[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,1,3\}$. As described using $\mathbf{8}\{2,1,3\}$ ( $132 \mathrm{mg}, 0.316 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(108 \mathrm{mg}, 0.695 \mathrm{mmol})$, and DMAP ( $8 \mathrm{mg}, 0.063 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a
gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $9 \mathrm{mg}(8 \%)$. LC-MS $=1.39 \mathrm{~min} ;$ ESI MS $m / z 365[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,1,4\}$. No starting material available.
$\mathbf{9}\{2,2,1\}$. As described using $\mathbf{8}\{2,2,1\}$ ( $105 \mathrm{mg}, 0.251 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(86 \mathrm{mg}, 0.552 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.050 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{2,2,2\}$. As described using $\mathbf{8}\{2,2,2\}(110 \mathrm{mg}, 0.254 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(87 \mathrm{mg}, 0.559 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.051 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $7 \mathrm{mg}(7 \%)$. LC-MS $=1.43 \mathrm{~min} ;$ ESI MS $m / z 379[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,2,3\}$. As described using $\mathbf{8}\{2,2,3\}$ ( $128 \mathrm{mg}, 0.295 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(101 \mathrm{mg}, 0.649 \mathrm{mmol})$, and DMAP ( $7 \mathrm{mg}, 0.059 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $9 \mathrm{mg}(8 \%)$. LC-MS = $1.38 \mathrm{~min} ;$ ESI MS m/z $379[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,2,4\}$. No starting material available.
$\mathbf{9}\{2,3,1\}$. As described using $\mathbf{8}\{2,3,1\}$ ( $111 \mathrm{mg}, 0.257 \mathrm{mmol}$ ), EDC $\cdot \mathrm{HCl}(88 \mathrm{mg}, 0.565 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.051 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $2 \mathrm{mg}(3 \%)$. LC-MS $=1.39 \mathrm{~min} ;$ ESI MS $m / z 365[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,3,2\}$. As described using $\mathbf{8}\{2,3,2\}$ ( $118 \mathrm{mg}, 0.272 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(93 \mathrm{mg}, 0.598 \mathrm{mmol})$, and DMAP ( $7 \mathrm{mg}, 0.054 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex $(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded $11 \mathrm{mg}(10 \%)$. LC-MS $=1.47 \mathrm{~min} ;$ ESI MS $m / z 379[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,3,3\}$. As described using $\mathbf{8}\{2,3,3\}$ ( $139 \mathrm{mg}, 0.321 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(110 \mathrm{mg}, 0.706 \mathrm{mmol})$, and DMAP ( $8 \mathrm{mg}, 0.064 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex $(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded $11 \mathrm{mg}(9 \%)$. LC-MS $=1.49 \mathrm{~min} ;$ ESI MS m/z $379[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,3,4\}$. No starting material available.
$\mathbf{9}\{2,4,1\}$. As described using $\mathbf{8}\{2,4,1\}(114 \mathrm{mg}, 0.247 \mathrm{mmol}), \mathrm{EDC} \cdot \mathrm{HCl}(84 \mathrm{mg}, 0.543 \mathrm{mmol})$, and DMAP ( $6 \mathrm{mg}, 0.049 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by $\mathrm{EtOAc} / \mathrm{MeOH}(1: 19 \rightarrow 3: 2)$ yielded $8 \mathrm{mg}(8 \%)$. LC-MS $=1.51 \mathrm{~min} ;$ ESI MS $m / z 407[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,4,2\}$. As described using $\mathbf{8}\{2,4,2\}$ ( $42 \mathrm{mg}, 0.089 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(30 \mathrm{mg}, 0.196 \mathrm{mmol})$, and DMAP ( $2 \mathrm{mg}, 0.018 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a
gradient of $\mathrm{EtOAc} / \mathrm{Hex}(1: 1 \rightarrow 1: 0)$ followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded $4 \mathrm{mg}(11 \%)$. LC-MS $=1.61 \mathrm{~min} ;$ ESI MS $m / z 421[\mathrm{M}+\mathrm{H}]^{+}$.
$\mathbf{9}\{2,4,3\}$. As described using $\mathbf{8}\{2,4,3\}(135 \mathrm{mg}, 0.285 \mathrm{mmol})$, $\mathrm{EDC} \cdot \mathrm{HCl}(97 \mathrm{mg}, 0.627 \mathrm{mmol})$, and DMAP ( $7 \mathrm{mg}, 0.057 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH (1:19 $\rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.
$\mathbf{9}\{2,4,4\}$. As described using $\mathbf{8}\{2,4,4\}$ ( $115 \mathrm{mg}, 0.223 \mathrm{mmol}$ ), $\mathrm{EDC} \cdot \mathrm{HCl}(76 \mathrm{mg}, 0.491 \mathrm{mmol})$, and DMAP ( $5 \mathrm{mg}, 0.045 \mathrm{mmol}$ ). The reaction was stirred for 14 h . Column chromatography using a gradient of EtOAc/Hex ( $1: 1 \rightarrow 1: 0$ ) followed by EtOAc/MeOH ( $1: 19 \rightarrow 3: 2$ ) yielded no obvious fractions with the desired product as determined by LC-MS analysis.

Figure S1. LC-MS of $\mathbf{9}\{1,1,1\}$.


Figure S2. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,1,1\}$.


Figure S3. LC-MS of $\mathbf{9}\{1,1,2\}$.


Figure S4. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,1,2\}$.


Figure S5. LC-MS of $\mathbf{9}\{1,1,3\}$.

\begin{tabular}{|c|c|}
\hline maù \&  <br>
\hline MCo \&  <br>
\hline  \&  <br>
\hline 100\%
75\%

50\%

25\% \&  <br>
\hline
\end{tabular}

Figure S6. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,1,3\}$.


Figure S7. LC-MS of $\mathbf{9}\{1,1,4\}$.


Figure S8. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,1,4\}$.


Figure S9. LC-MS of $\mathbf{9}\{1,2,2\}$.


Figure S10. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,2,2\}$.


Figure S11. LC-MS of $\mathbf{9}\{1,2,4\}$.


Figure S12. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,2,4\}$.


Figure S13. LC-MS of $\mathbf{9}\{1,3,2\}$.

\begin{tabular}{|c|c|}
\hline $$
\begin{gathered}
\text { mAU } \\
\hline
\end{gathered}
$$ \&  <br>
\hline MCoun 25 20 15 10 0 \& $50: 800$ <br>
\hline  \&  <br>
\hline 100\%

$75 \%$

$50 \%$ \&  <br>
\hline
\end{tabular}

Figure S14. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,3,2\}$.


Figure S15. LC-MS of $\mathbf{9}\{1,3,4\}$.


Figure S16. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,3,4\}$.


Figure S17. LC-MS of $\mathbf{9}\{1,4,2\}$.


Figure S18. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,4,2\}$.


Figure S19. LC-MS of $\mathbf{9}\{1,4,3\}$.

| mAU | \||ceriii-82-10-1.run 214.00 |
| :---: | :---: |
| MCoum 60 50 40 30 20 10 |  |
| MCourt $30-$ 25 $20-$ $15-$ $10-$ $5-$ 0 |  |
|  |  |
| 100\% |  |
|  |  |

Figure S20. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{1,4,3\}$.


Figure S21. LC-MS of $\mathbf{9}\{2,1,2\}$.


Figure S22. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,1,2\}$.


Figure S23. LC-MS of $\mathbf{9}\{2,1,3\}$.

| maU |  |
| :---: | :---: |
|  |  |
|  |  |
| 100\% |  |
|  |  |

Figure S24. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,1,3\}$.


Figure S25. LC-MS of $\mathbf{9}\{2,2,2\}$.


Figure S26. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,2,2\}$.


Figure S27. LC-MS of $\mathbf{9}\{2,2,3\}$.


Figure S28. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,2,3\}$.


Figure S29. LC-MS of $\mathbf{9}\{2,3,1\}$.


Figure S30. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,3, l\}$.


Figure S31. LC-MS of $\mathbf{9}\{2,3,2\}$.


Figure S32. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,3,2\}$.


Figure S33. LC-MS of $\mathbf{9}\{2,3,3\}$.


Figure S34. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,3,3\}$.


Figure S35. LC-MS of $\mathbf{9}\{2,4,1\}$.

| maU- $30-1$ $20-1$ $10-$ $0-10-$ $-20-1$ $-30-$ |  |
| :---: | :---: |
| MCour 50 40 30 20 10 |  |
| MCoun <br> 15 <br> 10 <br> 5 <br> 0 |  |
|  |  |
| 100\% |  |

Figure S36. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,4,1\}$.


Figure S37. LC-MS of $\mathbf{9}\{2,4,2\}$.


Figure S38. ${ }^{1} \mathrm{H}$-NMR Spectra of $\mathbf{9}\{2,4,2\}$.


