Experimental

General Methods. ^{1}H and ^{13}C NMR spectra were recorded at 270 (67.8) or 400 (100) MHz at ambient temperature with $CDCl_3$ as solvent (unless otherwise noted). Tetramethylsilane was used as internal standard. Peak assignments of the cyclized products were made by ^{13}C–^{13}C and ^{1}H–^{13}C correlation experiments. Coupling constants are given as absolute values. Low resolution electron-impact MS spectra were measured at an ionization potential of 70 eV. The mass detector was interfaced with a gas chromatograph equipped with a HP-1 (25 m × 0.2 mm) column. Isomers were assumed to have the same response factors. Elemental analyses were performed by Mikro Kemi AB, Uppsala, Sweden or by Analytische Laboratorium, Prof. Dr. H. Malissa und G. Reuter GmbH, Gummersbach, Germany. High resolution MS analysis were performed by Dr. S. Gohil, Department of Chemistry, SLU, Uppsala, Sweden, or by E. Nilsson, Instrumentstationen, Kemicentrum, Lund. Melting points were determined in open capillary tubes in a melting point microscope and are uncorrected. Thin layer chromatography (TLC) was carried out on aluminium sheets pre-coated with silica gel 60 F_{254} (0.25 mm, Macherey-Nagel). Column chromatography was performed on silica gel S (0.032–0.063 mm, Riedel-de Haën) or silica gel 60 (fine) (0.015–0.040 mm, E. Merck) and centrifugal chromatography was carried out on a Harrison Research Chromatotron (model 7924T) with silica gel 60 PF_{254} containing gypsum (E. Merck) as solid phase. Preparative HPLC was performed on a Dynamax-60 Å 21.4 × 250 mm, 8-mm silica column (Si 83-1210), and the flow was set to 13mL/min.

Materials. Triethylamine was distilled from potassium hydroxide prior to use. Dry THF and diethyl ether were obtained by distillation from sodium/benzophenone before use. Acetonitrile (CH_3CN) was stored over activated 3Å molecular sieves and degassed with argon before use. 1-*N*-Phenoxycarbonyl-6-[(trifluorometylsulfonyl)oxy]-1,2,3,4-tetra-hydropyridine (**12**) was prepared according to a procedure developed by Comins.[9] *N*-(5-Chloro-2-pyridyl)triflimide[21] was prepared from 5-chloro-2-aminopyridine obtained from Aldrich. 3-*O*-Pyridyl *N*,*N*-diethylcarbamate was prepared from 3-hydroxypyridine (obtained from Aldrich) according to a known procedure[19] and used for the preparation of

3-hydroxy-4-iodopyridine.[20] All other compounds and reagents were obtained from commercial sources and used as received.

3-Acetoxy-2-bromopyridine (9). 2-Bromo-3-hydroxypyridine (4.0 g, 23 mmol) and acetic anhydride (3.5 g, 34 mmol) was heated to reflux for 1 h. The mixture was poured onto ice, neutralized with Na_2CO_3 and extracted with diethyl ether (3 × 25 mL). The combined organic layers were washed with water (2 × 25), brine (25 mL) and dried (Na_2SO_4). Concentration and purification by column chromatography (SiO_2, petroleum ether/EtOAc 3:1) followed by Kugelrohr distillation (oven temp 85–88 °C, 0.5 mmHg) gave **9a** (4.5 g, 90%) ^{1}H NMR δ 8.29 (dd, *J* = 4.7 and 1.8 Hz, 1H), 7.48 (dd, *J* = 7.8 and 1.8 Hz, 1H), 7.32 (dd, *J* = 7.8 and 4.7 Hz, 1H), 2.39 (s, 3H); ^{13}C NMR δ 168.1, 147.1, 145.5, 136.6, 131.68, 123.5, 20.9; MS [IP 70eV; *m/z* (% rel. int)]: 217 (6), 215 (M^+, 6), 175 (59), 173 (59). Anal. Calcd for $C_7H_6BrNO_2$: C, 38.92; H, 2.80; N, 6.48. Found: C, 39.0; H, 2.8; N, 6.5.

3-Acetoxy-2-[2-(trimethylsilyl)ethynyl]pyridine (10). $PdCl_2(PPh_3)_2$ (0.68 g, 0.95 mmol) and CuI (0.18 g, 0.97 mmol) were dissolved in triethylamine (64 mL) and THF (190 mL) under a stream of argon. A solution of compound **9** (7.0 g, 30 mmol) and trimethylsilylacetylene (3.8 g, 38 mmol) in THF (50 mL) was added in one portion and the mixture was stirred at room temperature for 1 h. Diethyl ether (300 mL) was added and the precipitate was filtered off. The clear solution was washed with saturated aqueous NH_4Cl (3 × 25 mL), water (2 × 25 mL), brine (25 mL) and dried (Na_2SO_4). Concentration and purification by column chromatography (SiO_2, diethyl ether/isohexane 1:1) followed by Kugelrohr distillation (oven temp ≈ 150 °C, 0.3 mmHg) gave **10** (6.25 g, 83%) as a yellow oil: ^{1}H NMR δ 8.46 (dd, *J* = 4.7 and 1.5 Hz, 1H), 7.46 (dd, *J* = 8.3 and 1.5 Hz, 1H), 7.29 (dd, *J* = 8.3 and 4.7 Hz, 1H), 2.36 (s, 3H), 0.27 (s, 9H); ^{13}C NMR δ 168.1, 149.0, 147.1, 137.1, 129.9, 123. 7, 100.6, 98.8, 20.8; –0.4; MS [IP 70eV; *m/z* (% rel. int)]: 233 (M^+, 6), 218 (11), 191 (41), 176 (100). Anal. Calcd for $C_{12}H_{15}NO_2Si$: C, 61.77; H, 6.48; N, 6.00. Found: C, 61.4; H, 6.4; N, 6.1.

3-Acetoxy-2-ethynylpyridine (11). Compound **10** (4.0 g, 17 mmol) was dissolved in THF (100 mL) and water (12 mL). The solution was cooled to 0 °C and tetrabutylammonium fluoride (20 mL, 1 M in THF) was added. The reaction mixture was stirred at room temperature until TLC (SiO_2, pentane/diethyl ether 1:1) indicated complete consumption of **10**. After 1 h, water (40 mL) was added and the volume was reduced to 100 mL in vacuum. Diethyl ether (50 mL) was added and the organic layers were separated. The aqueous layer was extracted with diethyl ether (3 × 25 mL). The combined organic extracts were washed with water (20 mL), brine (20 mL), dried (Na_2SO_4) and concentrated. Purification by column chromatography (SiO_2, pentane/diethyl ether 1:1) followed by Kugelrohr distillation (oven temp ≈ 125 °C, 0.2 mmHg) gave **11** (2.3 g, 83%) as a colourless oil which solidified upon standing, mp 41–42 °C: ^{1}H NMR δ 8.48 (dd, *J* = 4.7 and 1.5 Hz, 1H), 7.49 (dd, *J* = 8.2 and 1.5 Hz, 1H), 7.34 (dd, *J* = 8.2 and 4.7 Hz, 1H), 3.36 (s, 1H), 2.38 (s, 3H); ^{13}C NMR δ 168.4, 149.2, 147.3, 136.3, 130.2, 124.2, 82.1, 78.3, 20.9; MS [IP 70eV; *m/z* (% rel. int)]: 161 (M^+, 16), 119 (100), 91 (37). Anal. Calcd for $C_9H_7NO_2$: C, 67.08 H, 4.38 N, 8.69. Found: C, 66.9; H, 4.4; N, 3.8.

***N*-Phenoxycarbonyl-6-{2-[(3-acetoxy)-2-pyridinyl]ethynyl}-1,2,3,4-tetrahydropyridine (13).** $PdCl_2(PPh_3)_2$ (0.29 g, 0.42 mmol) and CuI (0.08 g, 0.42 mmol) were dissolved in triethylamine (27 mL) and THF (84 mL) under a stream of argon and stirred at room temperature for 10 min. A solution of compound **12**[9] (4.9 g, 14 mmol) and compound **11** (2.5 g, 15 mmol) in THF (35 mL) were added in one portion. The reaction was stirred until TLC (SiO_2, diethyl ether) indicated consumption of **12**. After 1 h, diethyl ether (100 mL) was added and the precipitate was filtered off. The clear solution was washed with saturated aqueous NH_4Cl (3 × 15 mL), water (2 × 15 mL), brine (2 × 15 mL) and dried (Na_2SO_4). Concentration and purification by column chromatography (SiO_2, diethyl ether) gave a yellow oil, which solidified upon standing. Recrystallization (diethyl ether/pentane/THF) yielded **13** (3.6 g, 70%) which was used in the next step without further purification. Analytically pure product was obtained by repeated recrystallization (diethyl ether /pentane), mp 73–74 °C. ^{1}H NMR δ 8.44 (dd, *J* = 4.7 and 1.5 Hz, 1H), 7.41

(dd, *J* = 8.4 and 1.5 Hz, 1H), 7.38–7.15 (m, 6H), 5.95 (t, *J* = 4.2 Hz, 1H), 3.83–3.79 (m, 2H), 2.35–2.28 (m, 2H), 2.12 (s, 3H), 1.99–1.90 (m, 2H); ^{13}C NMR δ 168.7, 151.8, 151.1, 148.4, 147.2, 137.3, 130.1, 129.2, 126.1, 125.5, 123.3, 121.8, 121.3, 90.1, 83.7, 44.2, 23.8, 22.4, 20.6. MS [IP 70eV; *m/z* (% rel. int)]: 362 (32), 227 (100), 158 (32). Anal. Calcd for $C_{21}H_{18}N_2O_4$: C, 69.60 H, 5.01 N, 7.73. Found: C, 69.8 H, 5.0 N, 7.8.

***N*-Phenoxycarbonyl-6-{2-[(3-acetoxy)-2-pyridinyl]ethyl}-1,2,3,4-tetrahydropyridine (14).** To a degassed solution of **13** (3.6 g, 9.9 mmol) and quinoline (0.066 g, 0.51 mmol) in EtOAc (230 mL) was added 10% Pd/C (0.59 g, 0.56 mmol). The suspension was vigorously stirred under H_2 (1 atm) and monitored by GLC. After 2 h the mixture was filtered and concentrated. Purification by column chromatography (SiO_2, pentane/diethyl ether/triethylamine 5:5:1) gave a yellow oil which solidified upon standing. Recrystallization (pentane/diethyl ether) gave **14** as white crystals (1.3 g, 36%) mp 62–63 °C: ^{1}H NMR δ 8.42 (dd, *J* = 4.7 and 1.6 Hz, 1H), 7.37–7.13 (m, 7H), 5.05 (t, *J* = 3.7 Hz, 1H), 3.70–3.66 (m, 2H), 2.95–2.26 (m, 4H), 2.22 (s, 3H), 2.06–2.03 (m, 2H), 1.86–1.82 (m, 2H); ^{13}C NMR δ 169.3, 153.9, 152.4, 151.1, 146.6, 145.4, 138.4, 129.9, 129.3, 125.4, 121.9, 121.8, 114.4, 45.5, 33.9, 31.4, 23.3, 22.9, 20.8; MS [IP 70eV; *m/z* (% rel. int)]: 266 (M^+, 13), 273 (23), 231 (100). Anal. Calcd for $C_{21}H_{22}N_2O_4$: C, 68.84; H, 6.05; N, 7.65. Found: C, 68.7; H, 6.0; N, 7.6.

***N*-Phenoxycarbonyl-6-{2-[(3-hydroxy)-2-pyridinyl]ethyl}-1,2,3,4-tetrahydropyridine (15).** To a stirred solution of **14** (1.9 g, 5.3 mmol) in methanol (40 mL), was added 1M $NaHCO_3$ (20 mL). The reaction was stirred until TLC (SiO_2, diethyl ether) indicated complete consumption of **14**. After 1.5 h water (20 mL) was added and the solvent volume was reduced to the half. The remaining slurry was extracted with diethyl ether (3 × 20 mL) and the combined organic layers were washed with water (10 mL), brine (10 mL), dried (Na_2SO_4) and concentrated. Recrystallization gave pure **15** (1.4 g, 78%) mp 125–126 °C: ^{1}H NMR δ 8.04 (dd, *J* = 4.7 and 1.5 Hz, 1H), 7.40–7.00 (m, 7H), 5.12 (t, *J* = 3.7 Hz, 1H), 3.83–3.79 (m, 2H), 3.10–3.00 (m, 2H), 2.88–2.81 (m, 2H), 2.15–2.08 (m,

2H), 1.94–1.88 (m, 2H); ^{13}C NMR δ 152.6, 151.6, 150.8, 148.1, 139.9, 138.0, 129.3, 125.6, 123.2, 122.8, 121.7, 114.1, 45.7, 34.2, 33.2, 23.1, 22.8. Anal. Calcd for $C_{19}H_{20}N_2O_3$: C, 70.35; H, 6.21; N, 8.64. Found: C, 69.9; H, 6.2; N, 8.6. HRMS (EI) m/z calcd for $C_{19}H_{20}N_2O_3$ 324.1474, found 324.1471.

***N*-Phenoxycarbonyl-6-(2-{[3-(trifluoromethylsulfonyl)oxy]-2-pyridinyl}-ethyl)-1,2,3,4-tetrahydropyridine (16).** To a solution of compound **15** (1.3 g, 3.9 mmol) and triethylamine (1.1 mL, 7.9 mmol) in CH_2Cl_2 (50 mL) was added trifluorometanesulfonic anhydride (0.72 mL, 4.2 mmol) at –78 °C. After 2 h, 1M $NaHCO_3$ (20 mL) was added and the mixture was allowed to reach room temperature. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 10 mL). The combined organic layers were washed with water (10 mL), brine (10 mL) and dried ($MgSO_4$). Purification by column chromatography (SiO_2, diethyl ether/isohexane 1:1) gave **16** as a yellow oil (1.4 g, 79%): ^{1}H NMR δ 8.56 (dd, *J* = 4.7 and 1.5 Hz, 1H), 7.57 (dd, *J* = 8.3 and 1.5 Hz, 1H), 7.40–7.14 (m, 6H), 5.03 (t, *J* = 3.8, 1H), 3.68–3.64 (m, 2H), 3.09 (app s, 4H), 2.06–2.02 (m, 2H), 186–1.82 (m, 2H); ^{13}C NMR δ 154.5, 152.6, 151.0, 148.8, 145.2, 138.1, 129.2, 128.8, 125.5, 122.5, 121.8, 118.5 (q, *J* = 320 Hz), 114.5, 45.5, 33.4, 30.8, 23.2, 22.9; MS [IP 70eV; *m/z* (% rel. int)]: 456 (M^+, 14), 363 (100), 323 (21), 230 (19). Anal. Calcd for $C_{20}H_{19}N_2F_3O_5S$: C, 52.63; H, 4.20; N, 6.14. Found: C, 53.0; H, 4.2; N, 6.0.

3-Hydroxy-4-iodopyridine (18). To a cooled (–78 °C), stirred solution of 3-*O*-pyridyl *N*,*N*-diethylcarbamate[19] (18 g, 91 mmol) and tetramethylethylenediamine (13 g, 110 mmol) in dry THF (350 mL), was added dropwise *n*-BuLi (75 mL, 105 mmol, 1.4 M in hexane). The solution was stirred at –78 °C for 1 h and thereafter I_2 (30 g, 119 mmol) was added and the reaction mixture was stirred at –78 °C for 1 h and then allowed to reach room temperature. Water (300 mL) was added and the volume was reduced to the half. The solution was extracted with diethyl ether (3 × 150 mL) and the combined organic layers were washed with 10% aqueous $Na_2S_2O_4$ (4 × 100 mL), water (100 mL), brine (100 mL) and dried (Na_2SO_4). Filtration trough SiO_2 eluting with isohexane/EtOAc

1:1 gave 4-iodo-3-*O*-pyridyl *N*,*N*-diethylcarbamate (22 g 76%), MS [IP 70eV; *m/z* (% rel. int)]: 320 (M^+, 7), 100 (100). 4-Iodo-3-*O*-pyridyl *N*,*N*-diethylcarbamate (22 g, 69 mmol) was dissolved in methanol (60 mL) and 2 M NaOH (60 mL) was added. The solution was refluxed overnight, after which the volume was reduced to the half and neutralized to pH 5–6. The precipitated product was filtered of and washed with water. Recrystallization (toluene) yielded **18** (9,6 g, 63%), mp 140 °C dec; ^{1}H NMR (DMSO) δ 8.08 (s, 1H), 7.74 (d, *J* = 4.5 Hz, 1H), 7.69 (d, *J* = 4.5 Hz, 1H); ^{13}C NMR (DMSO) δ 154.0, 140.8, 136.3, 133.6, 95.0; MS [IP 70eV; *m/z* (% rel. int)]: 221 (M^+, 100), 127 (12), 94 (24). Anal. Calcd for C_5H_4INO: C, 27.17; H, 1.82; N 6.24. Found: C, 27.4; H, 1.8; N, 6.3.

3-Acetoxy-4-iodopyridine (19). Compound **18** (8.5 g, 39 mmol) and acetic anhydride (20 mL) were heated at 70 °C for 30 min. After cooling, 75 mL of diethyl ether/pentane (1:5) was added and the precipitate was filtered of. Recrystallization ($CHCl_3$/isohexane) gave **19** (6.0 g, 59%), mp 109–110 °C dec; ^{1}H NMR δ 8.31 (s, 1H), 8.11 (d, *J* = 5.1 Hz, 1H), 7.80 (d, *J* = 5.1 Hz, 1H), 2.40 (s, 3H); ^{13}C NMR δ 168.1, 148.8, 147.4, 144.0, 134.1, 102.0, 21.0; MS [IP 70eV; *m/z* (% rel. int)]: 263 (M^+, 31), 221 (100). Anal. Calcd for $C_7H_6INO_2$: C, 31.96; H, 2.31; N, 5.33. Found: C, 32.0; H, 2.5; N, 5.3.

3-Acetoxy-4-[2-(trimethylsilyl)ethynyl]pyridine (20). Compound **20** was prepared from compound **19** (4.0 g, 15 mmol) as described for the synthesis of compound **10**. Purification by column chromatography (SiO_2, diethyl ether/pentane 1:1) followed by Kugelrohr distillation (oven temp ≈ 125 °C, 0.1 mmHg) gave **20** (3.2 g, 90%) as a yellow oil. ^{1}H NMR δ 8.44 (d, *J* = 5.0 Hz, 1H), 8.41 (app s, 1H), 7.37 (dd, *J* = 5.0 and 0.6 Hz, 1H), 2.36 (s, 3H), 0.26 (s, 9H); ^{13}C NMR δ 168.1, 147.7, 147.0, 144.1, 126. 3, 125.3, 105.4, 96.8, 20.6, –0.4; MS [IP 70eV; *m/z* (% rel. int)]: 233 (M^+, 8), 218 (10), 191 (21), 176 (100). Anal. Calcd for $C_{12}H_{15}NO_2Si$: C, 61.77; H, 6.48; N, 6.00. Found: C, 61.4; H, 6.4; N, 6.1.

3-Acetoxy-4-ethynylpyridine (21). Compound **21** was prepared from compound **20** (3.0 g, 12.9 mmol) as described for the synthesis of compound **11**. Recrystallization (diethyl ether/pentane) gave **21** (1.1 g, 54%) as white needles, mp 53–54 °C; ^{1}H NMR δ 8.47 (d, *J* = 4.9 Hz, 1H), 8.45 (app s, 1H), 7.42 (dd, *J* = 4.9 and 0.4 Hz, 1H), 3.18 (s, 1H), 2.37 (s, 3H); ^{13}C NMR δ 168.3, 147.8, 147.0, 144.3, 126.8 124.4, 86.5, 76.2, 20.7; MS [IP 70eV; *m/z* (% rel. int)]: 161 (M^+, 15), 133 (15), 119 (100), 91 (46). Anal. Calcd for $C_9H_7NO_2$: C, 67.08; H, 4.38; N, 8.69. Found: C, 67.1; H, 4.4; N, 8.7.

***N*-Phenoxycarbonyl-6-{2-[(3-acetoxy)-4-pyridinyl]ethynyl}-1,2,3,4-tetrahydropyridine (22).** Compound **22** was prepared from compound **21** (0.30 g, 1.9 mmol) and compound **12**[9] (0.68 g, 1.9 mmol) as described for the synthesis of compound **13**. Purification by column chromatography gave **22** (0.52 g, 77%). Analytically pure compound was obtained by recrystallization from diethyl ether/pentane/THF, mp 112–113 °C; ^{1}H NMR δ 8.38 (d, *J* = 4.9 Hz, 1H), 8.37 (s, 1H), 7.40–7.15 (m, 6H), 5.86 (t, *J* = 4.2 Hz, 1H), 3.84–3.8 (m, 2H), 2.37–2.30 (m, 2H), 2.20 (s, 3H), 1.98–1.94 (m, 2H); ^{13}C NMR δ 168.5, 151.8, 151.0, 147.0, 146.8, 144.2, 129.3, 126.1, 126.0, 125.6, 125.3, 121.5, 121.3, 94.6, 81.5, 44.2, 23.8, 22.3, 20.6; MS [IP 70eV; *m/z* (% rel. int)]: 362 (M^+, 55), 320 (20), 269 (44), 227 (100). Anal. Calcd for: $C_{21}H_{18}N_2O_4$ C, 69.60; H, 5.01; N, 7.73. Found: C, 69.6; H, 5.0; N, 7.7.

***N*-Phenoxycarbonyl-6-{2-[(3-acetoxy)-4-pyridinyl]ethyl}-1,2,3,4-tetrahydropyridine (23).** Compound **23** was prepared from compound **22** (0.60 g, 1.7 mmol) as described for the synthesis of compound **14**. Purification by HPLC (isohexane/ ethanol 95:5) gave **23** (0.28 g, 42 %) as a colourless oil. ^{1}H NMR δ 8.36 (d, *J* = 4.9 Hz, 1H), 8.29 (s, 1H), 7.14–7.10 (m, 6H), 5.02 (t, *J* = 3.7 Hz, 1H), 3.69–3.65 (m, 2H), 2.89–2.84 (m, 2H), 2.74–2.68 (m, 2H), 2.28 (s, 3H), 2.11–2.04 (m, 2H), 1.90–1.83 (m, 2H); ^{13}C NMR δ 169.1, 152.3, 151.0, 147.0, 146.1, 144.1, 142.6, 137.8, 129. 4, 125.5, 124.9, 121.7, 114.7, 45.6, 34.5, 28.3, 23.2, 22.8, 20.7. MS [IP 70eV; *m/z* (% rel. int)]: 366 (M^+, 2), 307 (43), 231 (100). Anal. Calcd for $C_{21}H_{22}N_2O_4$ C: 68.84; H, 6.05; N, 7.65. Found: C, 68.6; H, 6.1; N, 7.6.

***N*-Phenoxycarbonyl-6-{2-[(3-hydroxy)-4-pyridinyl]ethyl}-1,2,3,4-tetrahydropyridine (24).** Compound **24** was prepared from compound **23** (0.22 g, 0.60 mmol) as described for the synthesis of compound **15**. Purification by column chromatography (SiO_2, $CHCl_3$/MeOH 10: 1) gave **24** (170 mg, 87%) as a white foamy oil. ^{1}H NMR δ 8.21 (s, 1H), 7.98 (d, *J* = 3.9 Hz, 1H), 7.40–7.12 (m, 5H), 7.06 (d, *J* =3.9 Hz, 1H), 5.09 (t, *J* = 3.5 Hz, 1H), 3.70–3.66 (m, 2H), 2.93–2.83 (m, 4H), 2.11–2.07 (m, 2H), 1.95–1.81 (m, 2H); ^{13}C NMR δ 153.5, 152.7, 151.0, 139.2, 138.4, 138.2, 136.0, 129.3, 125.5, 125.3, 121.7, 114.5, 45.6, 34.1, 28.6, 23.2, 22.8. HRMS (EI) *m*/*z* calcd for $C_{19}H_{20}N_2O_3$: 324.1474. Found: 324.1476.

***N*-Phenoxycarbonyl-6-{2-[(3-(trifluoromethylsulfonyl)oxy)-4-pyridinyl]-ethyl}-1,2,3,4-tetrahydropyridine (25).** To a stirred solution of compound **24** (420 mg, 1.3 mmol) and dry triethylamine (260 mg, 2.6 mmol) in dry CH_2Cl_2 (20 mL) was added *N*-(5-chloro-2-pyridyl)triflimide[21] (610 mg, 1.6 mmol) in one portion. The mixture was stirred at room temperature under nitrogen atmosphere until TLC indicated consumption of the starting material. The solution was evaporated onto silica and purified by chromatography (SiO_2, pentane/diethyl ether 1:1) to give **25** (420 mg, 70%) as a colourless oil. ^{1}H NMR δ 8.51 (s, 1H), 8.49 (d, *J* = 4.7 Hz, 1H), 7.42–7.11 (m, 6H), 5.06 (t, *J* = 3.7 Hz, 1H)3.70–3.66 (m, 2H), 2.93 (app s, 4H), 2.12–2.06 (m, 2H), 1.91–1.84 (m, 2H); ^{13}C NMR δ 152.6, 151.0, 149.3, 145.9, 143.9, 142.9, 137.4, 129.6, 125.9, 125.7, 121.8, 118.7 (q, *J* = 319 Hz), 115.1, 45.8, 34.4, 28.1, 23.2, 23.0. MS [IP 70eV; *m/z* (% rel. int)]: 456 (M^+, 4), 363 (96), 307 (100). Anal. Calcd for $C_{20}H_{19}F_3N_2O_5S$: C, 52.3; H, 4.20; N, 6.14. Found: C, 52.64; H, 4.08; N, 6.17. HRMS (EI) *m*/*z* calcd for $C_{20}H_{19}F_3N_2O_5S$: 324.1474. Found: 324.1476.

1'-(Phenylcarbamate)spiro[4-azaindan-1,2'-piperidine] (17). $Pd(OAc)_2$ (15 mg, 0.070 mmol) and (*R*)-(+)-BINAP (87 mg, 0.14 mmol) were mixed in CH_3CN (35 mL) under a stream of argon. Triethylamine (141 mg, 1.4 mmol) and **16** (320 mg, 0.70 mmol) were

added to the mixture. The reaction mixture was stirred and heated at 60 °C for 42 h. After cooling, the orange mixture was poured into saturated aqueous $NaHCO_3$/water (1:1, 120 mL) and extracted with EtOAc (3 × 40 mL), the combined organic layers were washed with brine (2 × 30 mL), dried (K_2CO_3) and concentrated. Purification by radial chromatography (EtOAc/isohexane 2:1) gave a mixture of double bond isomers (87 mg, 41%). The product mixture (87 mg, 0.28 mmol) and 10% Pd/C (30 mg, 0.028 mmol) were mixed in absolute ethanol (10 mL) and stirred under H_2 (1 atm) for 16 h. The mixture was filtered through celite and concentrated. Purification by column chromatography (SiO_2, EtOAc) gave **17** (78 mg, 90%, two steps 37%) ^{1}H NMR δ 8.35 (dd, *J* = 4.9 and 1.5 Hz, 1H, H-5), 7.49 (dd, *J* = 7.3 and 1.5 Hz, 1H, H-7), 7.21 (app t, 2H, *m*-Ar), 7.12–7.04 (m, 2H, *p*-Ar, H-6), 6.79 (app d, 2H, *o*-Ar), 4.18–4.10 (m, 1H, H-6'), 3.50–3.40 (m, 1H, H-6'), 3.22–3.13 (m, 1H, H-3), 3.38–2.41 (m, 1H, H-3), 2.47–2.39, (m, 2H, H-2), 1.93–1.62 (m, 6H, H-3', H-4', H-5') ^{13}C NMR δ 161.2 (C=O), 154.3, 150.7 (C-3a, Ar–O), 148.3 (C-5), 142.4 (C-7a), 129.6 (C-7), 128.9 (*m*-Ar), 124.9 (*p*-Ar), 121.1 (2 C's, *o*-Ar, C-6), 66.9 (C-1), 43.0 (C-6'), 37.1, 23.7, 18.7 (C-3', C-4', C-5'), 32.9 (C-2), 31.4 (C-3); MS [IP 70eV; *m/z* (% rel. int)]: 215 (100), 130 (27) Anal. Calcd for $C_{19}H_{20}N_2O_2$: C, 74.00; H, 6.54; N, 9.08. Found: C, 73.8; H, 6.4; N, 9.0. HRMS (CI+) *m/z* calcd for $C_{19}H_{21}N_2O_2$ 309.1603, found 309.1607.

Spiro[4-azaindan-1,2'-piperidine] (7). Compound **17** (64 mg, 0.21 mmol) was mixed with hydrazine monohydrate (42 mg, 0.83 mmol) in ethylene glycol (1.2 mL). A solution of KOH (140 mg, 2.5 mmol) in water (1.2 mL) was added and the mixture was refluxed until TLC indicated consumption of **17**. The reaction mixture was allowed to cool, diluted with brine (5 mL) and extracted with diethyl ether (3 × 5 mL). The combined organic layers were dried (K_2CO_3) and concentrated. Purification by column chromatography (SiO_2, EtOAc/isohexane/triethylamine 6:3:1) gave **7** (29 mg, 77%) as an oil. ^{1}H NMR δ 8.41 (dd, *J* = 4.9 and 1.6 Hz, 1H, H-5), 7.65 (dd, *J* = 7.7 and 1.6 Hz, 1H, H-7), 7.10 (dd, *J* = 7.7 and 4.9 Hz, 1H, H-6), 3.13–2.87 (m, 4H, H-3, H-6'), 2.40 (ddd, *J* = 13.2, 8.3 and 4.4 Hz, 1H, H-2), 2.11–2.02 (m, 1H, H-2), 1.86–1.52 (m, 7H, H-3',H-4', H-

5', NH); ^{13}C NMR δ 163.9 (C-3a), 149.2 (C-5), 143.2 (C-7a), 131.4 (C-7), 121.6 (C-6), 64.1 (C-1), 42.7 (C-6') 36.1, 25.9, 21.8 (C-3', C-4', C-5'), 34.3 (C-3), 31.6 (C-2); MS [IP 70eV; *m/z* (% rel. int)]: 188 (M^+, 73), 159 (100), 146 (84), 131 (52); HRMS (EI) *m/z* calcd for $C_{12}H_{16}N_2$ 188.1313, found 188.1315.

Spiro[6-azaindan-1,2'-piperidine] (8). $Pd(OAc)_2$ (15.4 mg, 0.070 mmol) and (*R*)-(+)-BINAP (87 mg, 0.14 mmol) were mixed in CH_3CN (35 mL) under a stream of argon. Triethylamine (141 mg, 1.4 mmol) and **25** (320 mg, 0.70 mmol) were added to the mixture. The reaction mixture was stirred and heated at 60 °C for 181 h. After cooling, the brown mixture was poured into saturated aqueous $NaHCO_3$/water (1:1, 120 mL) and extracted with EtOAc (3 × 40 mL), the combined organic layers were washed with brine (2 × 30 mL), dried K_2CO_3 and concentrated. Filtration through a plug of SiO_2 eluting with diethyl ether gave a mixture of double bond isomers and the uncyclized reduced product (99 mg). The product mixture (99 mg) and 10% Pd/C (34 mg, 0.032 mmol) were mixed in absolute ethanol (10 mL) and stirred under H_2 (1 atm) for 48 h. The mixture was filtered through celite and concentrated to yield the crude product (88 mg). The crude product (88 mg) was mixed with hydrazine monohydrate (57 mg, 1.1 mmol) in ethylene glycol (1.8 mL). A solution of KOH (191 mg, 3.4 mmol) in water (1.8 mL) was added and the mixture was refluxed overnight. The reaction mixture was allowed to cool, diluted with brine (6 mL) and extracted with diethyl ether (3 × 6 mL). The combined organic layers were dried (K_2CO_3) and concentrated. Purification by column chromatography (SiO_2, EtOAc/triethylamine 9:1) gave **8** (22 mg, 17%) as an oil. ^{1}H NMR δ 8.61 (s, 1H, H-7), 8.41 (d, *J* = 4.9 Hz, 1H, H-5), 7.16 (d, *J* = 4.9 Hz, 1H, H-4), 3.04–2.78 (m, 4H, H-3, H-6'), 2.48 (br s, 1H, NH) 2.33 (ddd, *J* = 13.2, 8.3 and 5.3 Hz, 1H, H-2), 2.14–2.95 (m, 1H, H-2), 1.90–1.56 (m, 6H, H-3', H-4', H-5'); ^{13}C NMR δ 152.4, 145.8 (C-3a, C-7a), 148.4 (C-5), 145.5 (C-7), 120.4 (C-4), 65.2 (C-1), 43.0 (C-6'), 36.0 (C-2), 29.6 (C-3), 25.9, 22.0 (C-4', C-5'); MS [IP 70eV; *m/z* (% rel. int)]: 188 (M^+, 76), 159 (95), 146 (100), 131 (55); HRMS (EI) *m/z* calcd for $C_{12}H_{16}N_2$ 188.1313, found 188.1316.