Substituted cyclohexane

Methyl cyclohexane

Axial groups have two problems:
1. gauche interaction w/ rest of ring
2. transannular interactions w/ other axial groups.

Gauche interaction

Boat structure is lower in energy by 10.7 kcal/mol.
The larger the substituent, the greater the preference for the equatorial position.

Only ~ 0.01% of the molecules have the t-Bu axial at equil.

What about two substituents?
Consider dimethylcyclohexane: 1,1 1,2 1,3 1,4

\[
\begin{align*}
&\text{cis} \\
&\text{trans}
\end{align*}
\]
would all be wedges in a flat drawing (angling up)

would all be hatches in a flat drawing (angling down)

which is axial? I don't know!
1,3
most stable
Cis

1,4
trans

Cis

* better

biggest substituent equatorial
(as many subs equatorial as possible)
Bigger rings are fairly common—more strain:
- bond angle distortion
- partial eclipsing interactions
- transannular interactions

Polycyclic hydrocarbons

Steroid nucleus

adamantane

trans-decalin

bicyclo[4.4.0]decan