5. Because \( ay(b - y) \) satisfies the conditions of the Existence-Uniqueness theorem for all values of \( x \) and \( y \), all solutions are unique. Therefore no other solution may intersect the equilibrium solution. Other solutions may approach the equilibrium solution as \( x \to \infty \), but not touch it.

7. (a) If \( c \) is very large, many animals are being poached and the population may die out.

(b) If \( y = bY/2 \), and \( x = 2X/(ab) \),
\[
dy/dx = d(bY/2)/dx = (b/2)dy/dx = (b/2)(dY/dX)(dX/dx) = (b/2)(dY/dX)(ab)/2.
\]
This means \( dy/dx = ay(b - y) - c \) becomes
\[
(ab^3/4)(dY/dX) = (abY/2)[b - bY/2] - c, \text{ or}
\]
d\( Y/dX = Y(2 - Y) - C \), where \( C = 4c/(ab^2) \).

(c) \( dY/dX = Y(2 - Y) - C \) has equilibrium solutions where \( Y^2 - 2Y + C = 0 \), or
\[
Y = (2 \pm \sqrt{4 - 4C})/2 = 1 \pm \sqrt{1 - C}.
\]
i. If \( C > 1 \) there are no equilibrium solutions. ii. If \( C = 1 \) there is one (repeated) equilibrium solution. iii. If \( C < 1 \) there are two equilibrium solutions: one larger than 1, one smaller than 1.

(d) If \( C = 1 \), the differential equation is \( dY/dX = -(1 - Y)^2 \), so solutions are always decreasing and the equilibrium solution is semistable. If \( C < 1 \), we may write the differential equation as \( dY/dX = -(Y - r_1)(Y - r_2) \), where \( r_1 = 1 - \sqrt{1 - C} \) and \( r_2 = 1 + \sqrt{1 - C} \). If \( Y > r_2 \), \( dY/dX < 0 \), while if \( r_1 < Y < r_2 \) we have \( dY/dX > 0 \). Thus \( Y = r_2 \) is a stable equilibrium solution. If \( Y < r_1 \), \( dY/dX < 0 \), so \( Y = r_1 \) is an unstable equilibrium solution.

(e) If \( C > 1 \), we may write the differential equation as \( dY/dX = -(1 - Y)^2 - C + 1 \), giving \( Y \) as a decreasing function of \( X \). As there are no equilibrium solutions, \( Y \) will always decrease, eventually reaching a value of 0.

(f) If \( C = 1 \), the population will die out if the initial condition gives \( Y(0) < 1 \). If \( C > 1 \), the population will die out if the initial condition gives \( Y(0) < r_1 \). (Notice it does not make sense to have \( Y(0) < 0 \).) The population will not die out, but have a limiting value of \( 1 + \sqrt{1 - C} \) if \( Y(0) > r_1 \).

9. (a) No. If the equilibrium solutions \( y(x) = 1 \), \( y(x) = 2 \), and \( y(x) = 3 \) were all stable, then \( y(x) \) would have to be an increasing function for \( y < 2 \) and a decreasing function for \( y > 1 \). Because solutions of autonomous differential equations have slopes which do not change sign between equilibrium solutions, this is impossible.

(b) No. The same reasoning for part (a) applies here.

(c) Yes. One example is \( y' = C(1 - y)(2 - y)^2(3 - y)^2 \), where \( C > 0 \). Many other examples are possible.