

water for homes, cities, agriculture, industry, stock watering, recreation, wildlife, power generation, and mining. Recent expansions of the meaning of *beneficial* have included dust-settling control and snow making. Historically, courts in western states have rejected very few uses of water as unbeneficial. One use not accepted as beneficial has been holding water for ecological uses. The fact that wildlife or a natural body of water needs water retained has not impressed the courts. However, a few courts have begun in recent years to rethink the meaning of *beneficial* and to apply it to ecological needs.

Under the doctrine of prior application, each water right has an annual quantity and drawing date assigned to it. Every year, the senior appropriators may draw out of the water source their full allotment of water. Since water is scarce, it is usually assumed that the water is available for allocation. Then, the next water right, which is the next earliest, may use the full application. In times of drought, the full application may not be used because the water is simply unavailable. In dry years, junior applicants may receive no water at all, although the senior applicant gets the full amount. Water rights may be sold. If they are sold, then the prior appropriation date travels with the sale. Also, only the amount of water historically used can be transferred with the sale. The application of prior appropriation to water used across state lines or across international boundaries often falls under federal jurisdiction.

Water rights under the doctrine of prior appropriation may also be mortgaged or encumbered as if they were rights to real property. In addition, the water does not have to be used on the land on which it originates nor on the land upon which the right is based. If a water right is not used for some beneficial purpose for a period of time, it may be forfeited under the doctrine of abandonment. The lapsing of water rights is rare. The details of the doctrine of prior appropriation vary from state to state. California uses a combination of both prior appropriation and the older common law riparian water rights. The doctrine is important in regions like much of the western United States, where water is a scarce resource. However, as the competition for water in states east of the Mississippi River has increased, the doctrine is beginning to influence water policies.

SEE ALSO: Riparian Areas; Riparian Rights; Water; Water Law.

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Prisoner's Dilemma (PD)

THE PRISONER'S DILEMMA (PD) is a concept from game theory that posits a tension between the benefits of cooperation versus noncooperation. In its narrative form, it proposes that two prisoners, both suspects of a crime, are held by the police in separate rooms for interrogation and pressed for either a confession or an accusation against the other prisoner. If both mutually accuse one another, both will serve a moderate sentence. If one accuses the other, who remains silent, the accused serves a lengthy sentence and the accuser goes free. If both remain silent, both serve minimal sentences. Clearly for both players, the best outcome is to remain silent. The temptation to accuse the other prisoner, however, and so gain the best individual outcome, tends to lead to a choice to mutually accuse one another, thus leading to a worst outcome for both.

This perplexing puzzle has long been applied to a great number of real-life problems, including scenarios involving the use of nuclear weapons between two countries. During the early 1980s theorists such as Robert Axelrod began to apply the PD toward understanding the Tragedy of the Commons and the evolution of cooperation. While the Tragedy of the Commons provides a useful model for explaining

why overexploitation of community-held resources might occur, it does not shed light on how communities might profitably control the use of the commons, which they have historically done.

The PD is a formal mathematical game model that represents results of an interaction with different payoffs and therefore takes into account the rewards and punishment for different actions. The two-person version of the game is as follows:

1. If both players cooperate, they both receive the same reward payoff (R);
2. If both players defect, they both receive the same punishment payoff (P);
3. If one player defects and the other cooperates, the cooperator gets the sucker's payoff (S) and the defector gets the temptation to defect payoff (T);
4. The temptation to defect must be larger than the reward for mutual cooperation, which must be larger than the punishment for mutual defection, which in turn must be larger than the sucker's payoff ($T > R > P > S$);
5. The reward for mutual cooperation must be larger than the sucker's payoff plus the temptation to defect payoff divided by two ($R > (S+T)/2$), so that the benefit to both over several turns is larger than if they would have mutually cooperated.

The best strategy for both players collectively is to cooperate with each other. The individual's best strategy is the temptation to defect for the higher payoff (see Figure 1). Therefore, a dilemma is created with an individual having to make a choice between defection (cheating), which is the best individual strategy (e.g., in Figure 1, the individual would gain 5 points), and cooperation, which yields the higher combined reward for both players (e.g., in Figure 1, the scores would total 6 points).

		Player B	
		Cooperate	Defect
Player A	Cooperate	R = 3	S = 0
	Defect	T = 5	P = 1

Figure 1: Prisoner's Dilemma Payoff Matrix

However, the simplicity of this game becomes more complex as varieties of the game add "real

world" rules to the game. In response to this, Axelrod applied the PD toward the explanation of cooperation within groups, which has influenced anthropological research of the Tragedy of the Commons. For example, Axelrod used the following rules in his analysis of iterated (repeated) PD games:

1. Players cannot enforce other players' strategies or commit themselves to a particular strategy;
2. The only history of past actions known to each player is their own history with the specific player, not actions with other players;
3. A player cannot refuse to play or prevent another player from an interaction;
4. A player cannot change the payoffs of another player.

Using these rules, Axelrod tested which strategy would succeed in playing this game by soliciting strategies from game theorists, scientists, and interested individuals. After each turn of the game, the ones with a higher total score would advance and the ones with the lower total would fall back. He found that tit-for-tat (TFT, or cooperating on the first interaction and then doing whatever the other player did on the previous move) resulted in the highest overall score in the tournament. Following Axelrod, other studies using different payoff matrices have found that TFT was not the best overall strategy, but contrite TFT (same as TFT, but if the other player defects, this strategy only defects once before cooperating again) is more stable. In other studies, another strategy was more successful than TFT, namely Pavlov, which continues the previous strategy if the player wins (rewarding cooperation), changing strategy upon losing (punishing defection).

SEE ALSO: Externalities; Game Theory; Nash Equilibrium; Tragedy of the Commons.

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Pristine Myth

THE PRISTINE MYTH may have begun with Christopher Columbus upon his return to Spain after his first voyage. The lifestyle of the natives in the Caribbean region had made it seem like the original paradise to him. As reports of the discoveries in what was eventually seen as the New World filtered across Europe, there arose the idea that the New World was pristine, unlike the Europe that was close at hand. It became a favorite device of social criticism to hold aloft the pristine or innocent natives there as a mirror exposing the faults of Europeans. This same method of social criticism has been practiced in America and elsewhere in the New World.

The reality is that while undeveloped by European standards, the New World as known to Columbus or as later described by Charles Darwin and others was not pristine. It had been modified to a degree by the Native Americans. When the first people came to the Americas, probably 30,000 or more years ago, the continents were indeed pristine. However, by the end of the last Ice Age many species had disappeared. The megafauna of mastodons, saber-toothed tigers, camels, horses, the dire wolf, and other animals vanished. It is now suspected that either hunting or changes in the environment wrought by fires or other means killed off these animals. There is probably no way to know what species of plants may have been lost.

As a consequence, while it is tempting to see the great forests of North America as pristine when the first colonists arrived at Jamestown, or in Canada, the reality is that the Native Americans had already made significant changes to the environment. What these changes were may never be fully known. For decades it has been taught in American schools that when the colonists arrived they found an untouched wilderness; it was a Garden of Eden that was soon

spoiled by the settlers. Teaching this way "mirrors" bad practices from good environmental practices.

There is now a growing body of evidence that suggests that the modifications made in the Western Hemisphere in the pre-Columbian era were significant. Some have conjectured that the Amazon rain forest is an artifact of human effort. Increasing numbers of archeologists, anthropologists, geographers, and others are now viewing the Native Americans as less than ecologically pure hunters and farmers.

The pristine myth is important to many environmental groups because their agenda is to restore wilderness areas to an original pristine condition. It allows them to argue that the environment began pristine, was spoiled, and should now be restored.

SEE ALSO: Colonialism; Conservation; National Parks; Preservation; Wilderness.

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Private Property

PROPERTY RIGHTS DETERMINE who is entitled to use and dispose of resources, both natural and man-made. Private property is a form of property ownership in which an individual, company, or corporation enjoys the associated rights. It thus differs from common property (where a group of people enjoys those rights jointly), state property (where the sovereign ruler or nation is the presumed owner, with the state managing the property), and open access (in which case no property rights have been established).

The nature of private property varies depending on which rights have been conferred upon resource owners by social institutions such as the state or