Monitoring the Endangered Species Act: Revisiting the Eastern North Pacific Gray Whale

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Abstract

The U.S. Endangered Species Act provides powerful legislation to conserve imperiled populations but provides little consideration for the long-term viability of species that are deemed "recovered" and subsequently removed from the ESA List. Since it's inception in 1973, a mere 15 species have been delisted from the ESA (Noecker 1998). The eastern north Pacific gray whale was the first marine mammal to be removed from the ESA and has been applauded as an endangered species "success" story (Gerber et al. 1999). In recent years, gray whales have experienced a steady population decline – in fact, the most recent abundance estimate suggests that the population has declined by 33% since delisting (Rugh 2003). In light of this population decline, in this paper we re-examine the risk of extinction and ESA status of eastern north Pacific gray whales. We determined that the current population decline does not warrant reclassification as threatened or endangered, but that longer timeseries are needed to obtain a realistic picture of population dynamics. Given the uncertain trajectory of delisted species, monitoring beyond the 5 years required by the ESA is needed to ensure long-term viability of species removed from the list.

Resumen

La ley de especies en peligro de extinción (ESA en Ingles) contiene legislación que facilita la conservación de las especies en peligro, pero presta poca atención a la viabilidad a largo plazo de las especies consideradas como "recuperadas" y removidas de la lista de especies en peligro de extinción (ESA). Desde sus inicios en 1973, tan solo 15 especies han sido removidas de la lista (Noecker 1989). La ballena gris del noreste en el océano Pacifico fue el primer mamífero removido de la lista ESA y considerada como éxito en la recuperación de especies (Gerber et al. 1999). Sin embargo, en años recientes las poblaciones de ballenas grises se han reducido constantemente; de hecho, las últimas estimaciones de la abundancia de sus poblaciones han declinado en un 33% desde que fueron removidas de la lista (Rugh 2003). En vista de la declinación de la población, en este articulo re-examinamos el riesgo de extinción y el status de la ballena gris del Pacifico en la lista ESA. Determinamos que la reciente declinación de la población no justifica su reclasificación como especie amenazada o en peligro de extinción, pero que se necesitan estudios de más larga duración para obtener una mejor imagen de su dinámica poblacional. Dada la incierta trayectoria de especies removidas de la lista, se hace necesario el monitoreo por mas de los cinco años requeridos por ESA para asegurar la viabilidad a largo plazo e especies removidas de la lista.

Introduction

Does delisting species under the Endangered Species Act (ESA) ensure that a species will remain viable in the foreseeable future? Because few species have been removed from the ESA, we have little empirical evidence from which to gauge our success in the conservation of endangered or threatened populations. Currently, about 1,800 species are protected under ESA regulations, and a mere 39 species have been removed from the list to date. Furthermore, of the 39 delisted species, only 15 species are considered recovered (Table 1). Current ESA provisions specify a 5-year monitoring period following delisting (U.S. Endangered Species Act, 1973) but consideration for long-term viability is lacking. The eastern North Pacific gray whale (*Eschrichtius robustus*) provides us with an interesting case study since it was the first marine mammal to be removed from the ESA and continuous monitoring has been conducted since its delisting in 1994 (Gerber et al. 1999). The population exhibited an increase in abundance during its protection under the ESA and during the 5-year monitoring period following its delisting (Figure 1). Ironically, abundance estimates following this 5-year period indicate a consistent decline in abundance - by 2002 the population had declined to 17,500 from 26,635 estimated in 1998 (Rugh 2003). Cumulatively, this decline represents a loss of 10,000 animals, constituting 1/3 of the total population estimated in 1998 (Rugh 2003). However, more recent work brings into question the significance of this decline and indicates other possible explanations for the low abundance estimate in 2002 (Anonymous 2004a, 2004b). The specific cause of this decline has not been determined but may be related to a change in carrying capacity (e.g., a decrease in prey species in Alaskan feeding grounds, Rugh 2003).

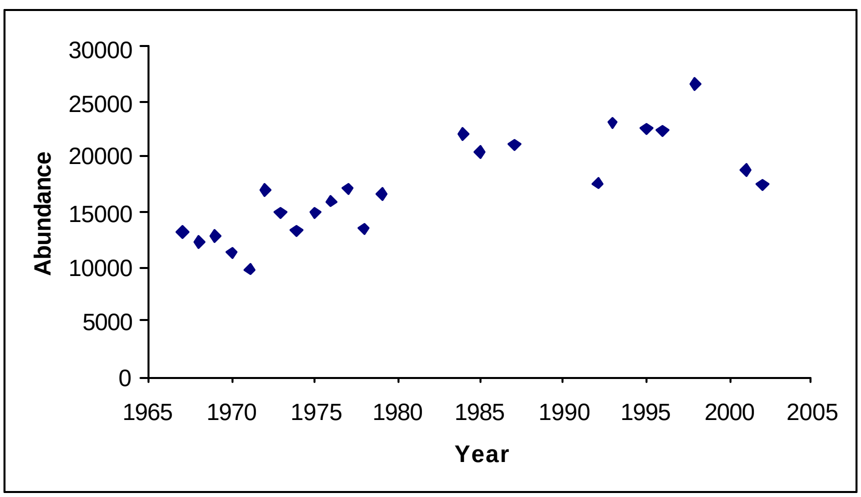

Figure 1. Abundance data for the eastern North Pacific Gray Whale. Census data during the period in which the population was listed under the ESA (1970-1994) show an increase in abundance. Post delisting abundance estimates indicate a decline following the five-year monitoring period (1994-1999).

Changes proposed to ESA policy in 2003 address the absence of long-term monitoring programs for delisted species but indicate that the current focus is on recovery programs for listed species (Federal Register 2003). These regulations do however indicate that future threats to declining populations must be taken into account before the threat is actually impacting the target species. Threats to delisted species are not specifically addressed in regulation and since few of the species removed from the ESA actually occur in areas within U.S. jurisdiction it is often difficult to predict future threats since they are not in our "backyard." Fortunately, many of our delisted species are protected by other pieces of legislation. For example, gray whales fall under the auspices of the International Convention for the Regulation of Whaling and the U.S. Marine Mammal Protection Act of 1972. Other legislation such as the U.S. Migratory Bird Treaty Act of 1918 and the Clean Water Act also provide limited protection for species that are removed from the ESA. These background laws do provide some measure of protection but some argue that until ample post delisting protection is available, maintaining species on the list of threatened and endangered wildlife may be the best approach to ensure the viability of an imperiled species until further legislation is enacted (Doremus 2001).

Conservation biologists are often faced with limited data concerning the fate of declining species, but must make policy decisions in the face of limited information (Doak and Mills 1994). Having time-series data of abundance estimates over 15 years is rare for long-lived vertebrates and even more rare for endangered species (Gerber et al. 1999). The value of having a long time-series of monitoring data for threatened or endangered populations has been demonstrated in other studies, which indicate that longer lengths of census data provide less uncertainty in listing recom-

Date Species First Listed	Date Delisted	Species Name	Reason Delisted
03/11/1967	06/04/1987	Alligator, American (*Alligator mississippiensis*)	Recovered
11/06/1979	10/01/2003	Barberry, Truckee (*Berberis (=Mahonia) sonnei*)	Taxonomic revision
02/17/1984	02/06/1996	Bidens, cuneate (*Bidens cuneata*)	Taxonomic revision
08/27/1984	02/23/2004	Broadbill, Guam (*Myiagra freycineti*)	Believed extinct
04/28/1976	08/31/1984	Butterfly, Bahama swallowtail (*Heraclides andraemon bonhotei*)	Act amendment
10/26/1979	06/24/1999	Cactus, Lloyd's hedgehog (*Echinocereus lloydii*)	Taxonomic revision
11/07/1979	09/22/1993	Cactus, spineless hedgehog (*Echinocereus triglochidiatus* var. *inermis*)	Not a listable entity
09/17/1980	08/27/2002	Cinquefoil, Robbins' (*Potentilla robbinsiana*)	Recovered
03/11/1967	09/02/1983	Cisco, longjaw (*Coregonus alpenae*)	Extinct
03/11/1967	07/24/2003	Deer, Columbian white-tailed Douglas County DPS (*Odocoileus virginianus leucurus*)	Recovered, threats removed
06/02/1970	09/12/1985	Dove, Palau ground (*Gallicolumba canifrons*)	Recovered
03/11/1967	07/25/1978	Duck, Mexican (U.S.A. only) (*Anas "diazi"*)	Taxonomic revision
06/02/1970	08/25/1999	Falcon, American peregrine (*Falco peregrinus anatum*)	Recovered
06/02/1970	10/05/1994	Falcon, Arctic peregrine (*Falco peregrinus tundrius*)	Recovered
06/02/1970	09/12/1985	Flycatcher, Palau fantail (*Rhipidura lepida*)	Recovered
04/30/1980	12/04/1987	Gambusia, Amistad (*Gambusia amistadensis*)	Extinct
04/29/1986	06/18/1993	Globeberry, Tumamoc (*Tumamoca macdougalii*)	New information discovered
03/11/1967	03/20/2001	Goose, Aleutian Canada (*Branta canadensis leucopareia*)	Recovered
10/11/1979	11/27/1989	Hedgehog cactus, purple-spined (*Echinocereus engelmannii* var. *purpureus*)	Taxonomic revision
12/30/1974	03/09/1995	Kangaroo, eastern gray (*Macropus giganteus*)	Recovered
12/30/1974	03/09/1995	Kangaroo, red (*Macropus rufus*)	Recovered
12/30/1974	03/09/1995	Kangaroo, western gray (*Macropus fuliginosus*)	Recovered
06/02/1977	02/23/2004	Mallard, Mariana (*Anas oustaleti*)	Believed extinct
04/26/1978	09/14/1989	Milk-vetch, Rydberg (*Astragalus perianus*)	Recovered
06/02/1970	09/12/1985	Owl, Palau (*Pyroglaux podargina*)	Recovered
06/14/1976	01/09/1984	Pearlymussel, Sampson's (*Epioblasma sampsoni*)	Extinct
06/02/1970	02/04/1985	Pelican, brown (U.S. Atlantic coast, FL, AL) (*Pelecanus occidentalis*)	Recovered
07/13/1982	09/22/1993	Pennyroyal, Mckittrick (*Hedeoma apiculatum*)	discovered
03/11/1967	09/02/1983	Pike, blue (*Stizostedion vitreu m glaucum*)	Extinct
10/13/1970	01/15/1982	Pupfish, Tecopa (*Cyprinodon nevadensis calidae*)	Extinct
09/26/1986	02/28/2000	Shrew, Dismal Swamp southeastern (*Sorex longirostris fisheri*)	New information discovered
03/11/1967	12/12/1990	Sparrow, dusky seaside (*Ammodramus maritimus nigrescens*)	Extinct
06/04/1973	10/12/1983	Sparrow, Santa Barbara song (*Melospiza melodia graminea*)	Extinct
11/11/1977	11/22/1983	Treefrog, pine barrens (FL pop.) (*Hyla andersonii*)	New information discovered
09/13/1996	04/26/2000	Trout, coastal cutthroat (Umpqua R.) (*Oncorhynchus clarki clarki*)	Taxonomic revision
06/14/1976	02/29/ 1984	Turtle, Indian flap-shelled (*Lissemys punctata punctata*)	Erroneous data
06/02/1970	06/16/1994	Whale, gray (except where listed) (*Eschrichtius robustus*)	Recovered
03/11/1967	04/01/2003	Wolf, gray U.S.A. (*Canis lupus*)	Taxonomic revision
07/19/1990	10/07/2003	Woolly-star, Hoover's (*Eriastrum hooveri*)	New information discovered

Table1. Species that have been removed for the list of Threatened and Endangered Wildlife, indicating date listed, date delisted and reason for delisting. A total of 39 species has been removed from the ESA but only 15 are considered recovered.

mendations (Gerber et. al 1999). While listing criteria developed for long-lived vertebrates use population viability analysis (PVA) models to determine listing recommendations, it is difficult to identify how much data is appropriate for PVA analysis and in many cases data may not be adequate to obtain reliable listing recommendations (Brook and Kikkawa 1998). Generally, data are unreliable or many times simply unavailable (Caughley and Gunn 1996). The extensive data available for the eastern Northern Pacific (ENP) gray whale provides us with a pertinent case study for identifying the role of post-delisting monitoring data in endangered species recovery. In this study we apply recently

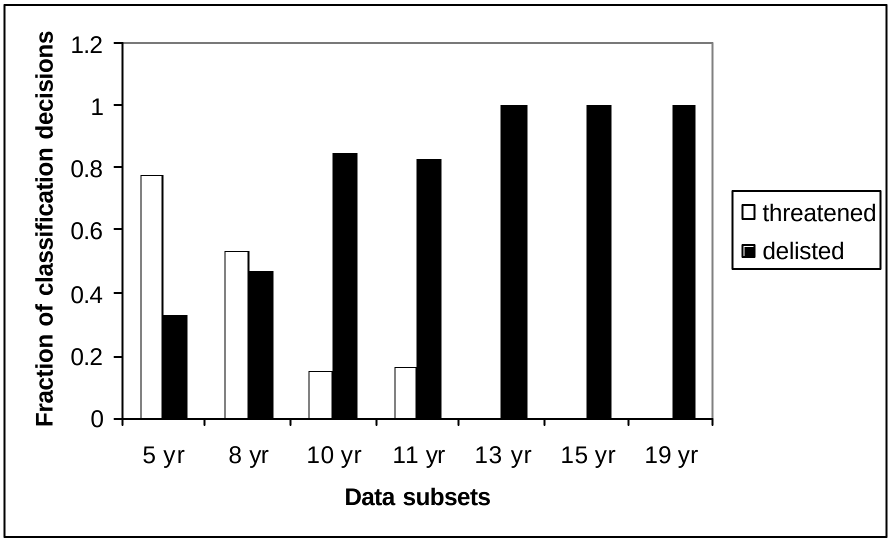

Figure 2. Classification decisions for data subsets. Data subsets containing thirteen years or more of census data unequivocally support a recommendation to keep the gray whale delisted from the ESA while smaller subsets yielded ambiguous listing recommendations.

developed quantitative criteria for deciding how to classify species (i.e., as endangered, threatened, or delisted, Gerber and DeMaster 1999) to the recently delisted gray whale.

Methods

I. Estimating Growth Rate Values

Using census data collected annually by the National Marine Fisheries Service (NMFS), we used a simple diffusion-approximation model (Dennis et al. 1991) to estimate the growth rate of the eastern North Pacific gray whale population. Since previous assessments failed to identify density dependence in gray whales (Gerber et al. 1999), we use an exponential model:

$$N_{t+1}=\lambda_t N_t$$

where N is the population and λ is the growth rate for year t. The model assumes that population variability is caused by environmental stochasticity and density-dependent variables that may influence population growth are not a factor. In light of uncertainty associated with density dependence in gray whales, this model is robust to violations of the density dependent assumption (Sabo et al. 2004).

II. Listing Criteria

The approach for species classification developed by Gerber and DeMaster (1999) for long-lived vertebrates focuses on three aspects of a population; population abundance and the tendency for this population to increase and decrease over time (μ) as well as variablility of growth rates (σ^2). The method developed by Gerber and DeMaster (1999) allows us to use the growth rate estimates from our diffusion approximation model and incorporate sampling error inherent in the fluctuating population. This approach is based on a probability-driven model of population demographics, which establishes threshold levels for threatened and endangered status by projecting a growth rate back from a specified quasi-extinction level (N_q). To determine endangered status, the population would have to have a >5% chance of falling below N_q (500 individuals; Best 1993) during the next 10 years. For the status of threatened, the population would have to have greater than a 5% chance of falling below the threshold level in the next 35 years. If the population remains above the threshold in both cases, the species should be considered for delisting from the ESA.

To examine the importance of post-delisting monitoring data on ESA listing decisions, we examined a variety of data subsets using abundance information on the eastern North Pacific gray whale. Following Gerber et al. (1999), data subsets ranged from 5, 8, 10, 11, 13, 15 and 21-year samples. For example, for 5-year intervals there were 18 possible combinations of data, and for 8-year intervals there were 15 combinations of data. Five-year samples were particularly relevant to illustrating the plausible consequences of the 5 years of monitoring mandated by the ESA on classification decisions.

Results and Discussion

Gerber et al. (1999) found that a quantitative decision to delist was unambiguously supported by eleven years of data, but precariously uncertain with fewer than ten years of data. Interestingly, the decision to delist is robust to the recent decline of 34% between 1997 and 2002. In particular, the application of the Gerber and DeMaster (1999) approach to current abundance data for the eastern North Pacific gray whale did not support a decision to reclassify this species as endangered or threatened. However, in light of the recent population decline, thirteen (vs. eleven) years of data are needed to unequivocally support a decision to delist (Figure 2). Furthermore, although the population has been declining at a rate of 34% for the last 4 years, the population growth rate needed to warrant reclassification as endangered is 0.881 and 0.905 for reclassification as threatened.

Our results convey the importance of analysis of post delisting monitoring data. If abundance estimates were not being conducted by the NMFS, the current decline may have gone unnoticed. There is a great deal of uncertainty about whether the recent decline is an acute event or an ongoing situation (Rugh 2003). Other large whale stocks may have recovered to the point where they may become delisted in the near future but without long-term monitoring programs, the fate of these species is uncertain. The development of recovery programs for listed species has become the main focus of the ESA. Our results emphasize the importance of including a long-term monitoring plan in the recovery program to ensure continued viability of listed species.

The effectiveness of the ESA has been evaluated by Doremus and Pagel (2001) who view the limited number of delisted species as a strength of the Act. While it may be beneficial for many imperiled populations to remain listed and benefit from the ESA's legal protection, this raises challenges in recovery programs for an increasing list of threatened and endangered species. Gerber (2003) points to the fact that without successful recovery stories there may be little political support for the ESA given its current track record. Furthermore, while the ESA may have been successful at preventing extinction for numerous species, promoting recovery (vs. preventing extinction) may be a more appropriate conservation goal for listed species. As the ESA develops in the future these and other issues need to be addressed with provisions for long-term monitoring being of high priority.

Monitoring of delisted species is only part of the formula we need to ensure the fate of these populations. The removal of current or potential threats is also an integral component. Of the recovered species taken off the ESA, overharvesting was the greatest threat to five of these recovered species that includes the ENP gray whale (Noecker 1998). It may be easy to enforce "no-take" legislation, but when a species is affected by factors such as environmental stochasticity, it is difficult or impossible to remedy these situations. One strength of collecting population data on a species is the ability to observe changes in a population before a crisis situation is obvious. This is demonstrated with the ENP gray whale example beacuse it was monitored biannually by the National Marine Fisheries Service for 6 years following delisting. However, given the difficulty in detecting declines on the order of 1-5% per year for populations with significant uncertainty in abundance estimates (Gerrodette 1987), we recommend consideration of longer time periods for post-delisting monitoring. Unfortuantely, current funding levels and associated proirities from Congress are such that future monitoring of the population is in question. It appears that Congress will have to provide specific advice and funding to the agencies responsible for implementing the ESA; otherwise the potential for suitably protecting apparently recovered populations will be lost.

The ESA has the ability to protect species ranging from small subalpine plants to large megafauna around the globe but each individual species listed under the ESA may require specialized monitoring programs. It will be difficult to porvide suitable rationale for a fixed period of post-delisting monitoring that works for all species, but efforts should be made to evaluate the merits of monitoring requirement on the order of 5 to 10 years. A lack of data may lead to inappropriate decisions and inconsistent management of imperiled species (Tear et al. 1993). Long term monitoring of delisted species can provide us with the information needed to determine if a population is "recovered" or if anthropogenic or environmental factors continue to affect long-term viability. The ability of the ESA to protect a target species has not been clearly demonstrated and monitoring provides us with a gauge for our successes and failures in the management of endangered and threatened populations.

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