JUSTIFICATION

Background

The Hawaiian monk seal, *Monachus schauinslandi*, also known Ilio-holo-i-ka-uaua in the Hawaiian language is one of only two endemic mammals in Hawaii. During the past two centuries large amounts of anthropogenic pressure has influenced a dramatic decline in the monk seal's population causing it to be listed as an endangered species in 1976. Present populations are estimated to be about 1,200 to 1,300 individuals living in both the Northwestern (NWHI) and the Main Hawaiian Islands (MHI).

There are many factors that are contributing to the demise of the Hawaiian monk seal. Some of the most destructive factors being directly attributed to humans starting with the large numbers of individuals that were hunted for their skins and oil starting in the late 19th century and now in modern times an insurmountable amount of marine debris. Compounding to the known factors affecting monk seals studies have shown that there are also unknown cause of mortality of juveniles occurring in the NWHI (MSRP 2007). The population in the MHI does not seem to be affected by the same unknown factors but, the population is still very small in comparison to those in the NWHI.

The first systematic population surveys in the MHI began in 2000 and counted 45 individuals. The yearly counts have shown a gradual increase in the population to be 77 individuals in 2005 (MSRP 2007). Births were surveyed in 2006 at 67. These occurrences might imply that monk seals are recolonizing the Main Hawaiian Islands. Monk seal population increases in the MHI will only cause more interactions with people.

Research Focus

Fishery interactions are listed by the Hawaiian Monk Seal Recovery Plan (2007) as a major threat that needs to be reduced. The most harmful fishery interactions are direct interactions involving fishing gear. Interactions with fishing gear and bait occurred 55 times within the years 1982-2006 across all the island chain (Nitta 1993). When the interactions occurred in the NWHI, it was with hooks. Many of the hooks were identified as federally managed bottomfish boats; however, because of management actions interactions in the NWHI are now nearly nonexistent. The National Marine Fisheries (NMFS) biological opinion is that there have been 7 hookings that could be identified as direct fishery interaction. NMFS calculated that one seal in 2.9 years will interact and 1 serious injury or death will occur every 6.7 years (MSRP 2007). A competition for food seems to be the reason for the interactions. Goodman & Lowe (2005) concluded from seal scat analysis there may be an overlap of NWHI bottomfishery bycatch with the monk seal's diet, which is made up 78% teleosts.

Interactions with hooks were not as common in the MHI, and when they did they were some from the state managed bottomfish fleet or they were from the shore based jack, *Caranx* sp., or also known as ulua fishery. However, the most predominate interaction in the MHI occurs with gillnets. One reported monk seal escaped, unaided by humans from a gillnet, but most interactions have occurred in death. Monk seals are opportunistic predators feeding during the day and at night. Henderson (1985) observed that seals had a natural curiosity for nets. The combination of these two characteristics may indicate why there is a higher instance of interactions with gillnets.

OBJECTIVES

- To determine whether monk seals have a stronger attraction to gillnets compared to hook and line fishing gear
    - Establishment that there is a significant attraction to gill nets
    - The evidence that gillnets are more attractive to seals can be used for the ban of gillnets in Hawaii or stricter regulations and enforcement of current laws
- To gain further information on the forging ecology for different cohorts of monk seals
    - Record of individuals to establish which cohorts are more vulnerable to fisheries interactions
    - More observations of monk seal behavior while they are foraging
- To use the information learned to create a public outreach program for fishers in the Main Hawaiian Islands
    - A statewide community education program, including literature, workshops, and conservation education
    - To help decrease the incidence of hookings from bottomfishing and to raise awareness of how vulnerable monk seals are to gillnets

METHODS

Laysan Island in the NWHI has the second largest colony of monk seals, having 277 individuals. Stuart (2004) found that the Laysan monk seals did not forage very far from the island except a few instances where seals went off the fringing reef out to sea.

These factors are why Laysan Island is a favorable study site. Fishing vessels are excluded from fishing in the waters 50nm from the center of each island making a 100nm perimeter around all NWHI to reduce interaction with seals. For this research vessels will be allowed to fish within this boundary to increase interactions with seals. NWHI bottomfish boats and crew will be charted to conduct this experiment. There will be a total of 6 boats using 3 different types of gear. The control boats will fish using traditional bottomfish gear. Boats in this fishery use 3-6 lines, each with 6-15 hooks, usually baited with squid. Hooks are spaced approximately 0.5 m intervals and are fished at depths of 120-250 m. A chum bag containing chopped fish or squid may be suspended above the highest of these hooks. The other four boats will use lay gillnets without the use of chum. Each gillnet will have 2 cameras on each side of the net to ensure that seals will not become entangled and drown. Two boats will use State of Hawaii regulations set for fishers stating that the net mesh must smaller be 5 inch stretched, a maximum net size of 125 feet long and 7 feet high. The gillnet is made of transparent monofilament and the net cordage that attaches the floats to keep the net upright and to the anchors to keep in on the bottom will be 2 inches. The other two boats will use gillnets that have a net mesh size the minimum regulation size of 2 ¾ inch stretched, a net size of 62 ½ feet long, and 3 ½ feet high. These nets are made of a less rigid knotless woven soft white nylon and the net cordage will be 1 inch. All boats will have observers trained in proper marine mammal handling.

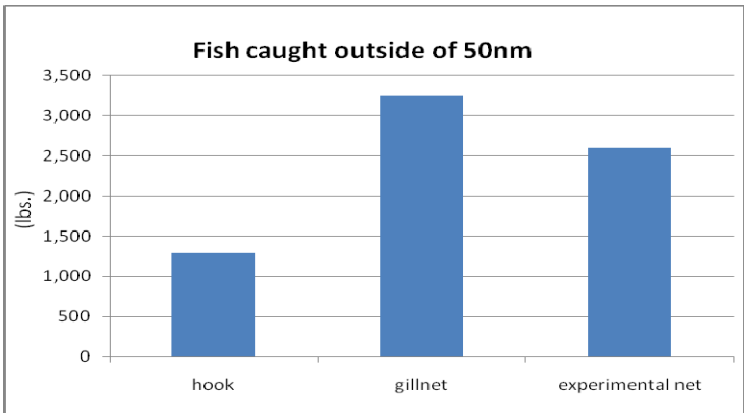
The fishing sites will be picked through stratified random sampling from confirmed bottomfish habitat by Kelley (2005) bottomfish habitat mapping project of the Hawaiian Island chain. All sites will be within a 60 nm radius from the center of Laysan

Island. Three of the six boats will fish outside the 50nm radius keeping the typical regulated areas. Each boat will deploy 2 nets each for 4 hour periods, one during the day and one at night. The experiments will be 12 sets weather allowing and if significant attractions occur further experimentation will follow. All boats will have an observer on board recording interactions of monk seal activity above and below the water. The observer will identify individuals as they interact with fishing gear. All the monk seals of the Laysan colony are marked with either bleach marks or natural markings, and in 2005 all 25 pups that were born in the colony are tagged with passive integrated transponders.

RESULTS

Fishery interactions increased for all fishing gear when the sets occurred within 50nm of Laysan Island. Not only did the catch increase, the of species diversity increased. The standard gill net caught 2.5 times more fish than the hook and line. The experimental gear caught less fish than the standard gillnet, but nearly 1.5 times more than the hook and line. This trend was seen regardless if the gear was set within 50nm or outside 50nm (Fig 1 & 2). The amount of fish caught at night was slightly higher than during the day. The experimental gear caught more fish at night than the standard gillnet.

Figure 1 and 2. The amount of fish caught on the three types of nets inside and outside the 50 nm boundary.



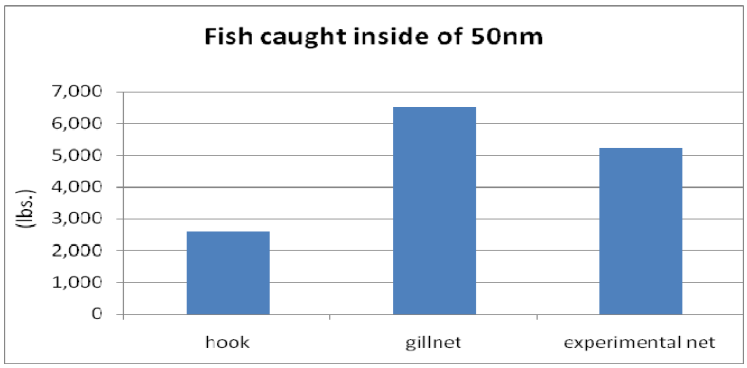
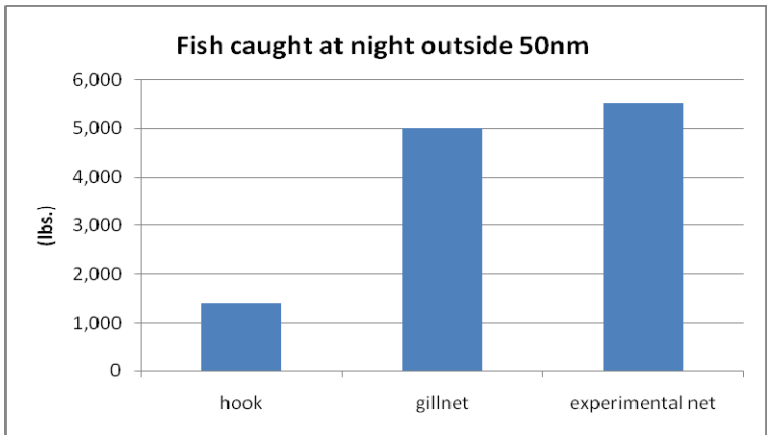
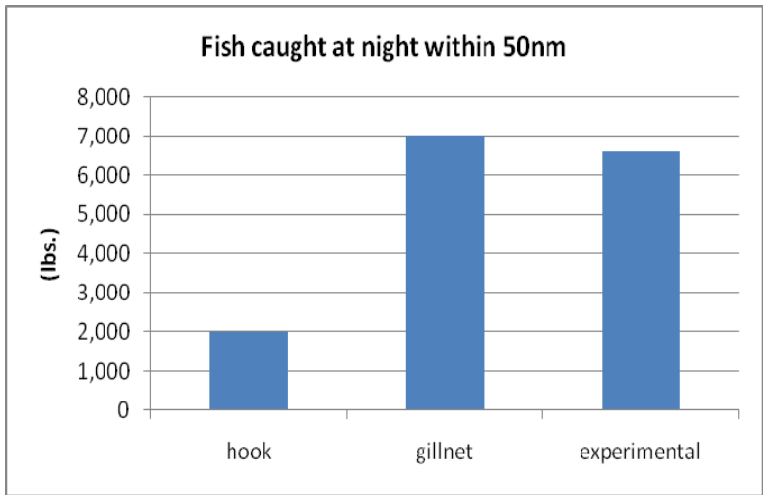


Figure 2 and 3. The amount of fish caught on all three tpes of gear inside and outside 50nm at night





Monk seals were observed interacting with fishing gear more often with gillnets over the hook and line gear. Standard gillnets attracted 4 times more seals than hook and line. There were twice as many interactions when the fishing boats were within 50nm of the island compared to out to sea. Most interactions occurred at night. Outside the 50nm boundary experimental nets attracted twice as many seals than hook and line gear. Standard gillnets attracted one more seal than the experimental nets. Inside 50nm seals interacted with all the gear twice as much as outside the boundary (3 & 4). The sets that occurred at night had much higher numbers of interactions than during the day. Outside

the boundary night time interactions with gillnets were 4 times higher than at night. Inside the boundary at night numbers were double of the interactions during the day (Fig 5 & 6).

Figure 3 and 4. The numbers of seals attracted to all types of gear inside and outside the 50nm boundary.

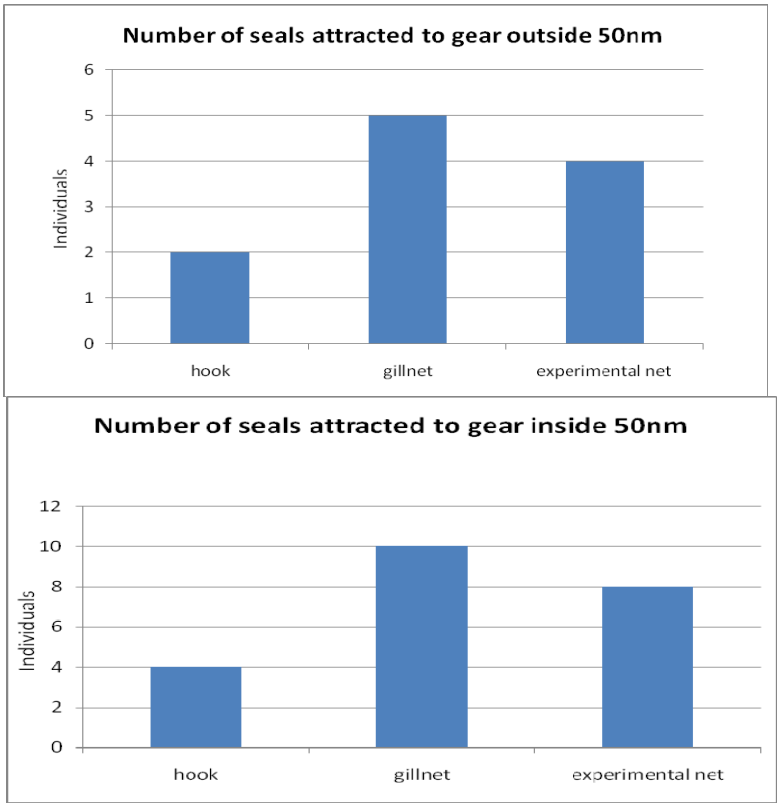
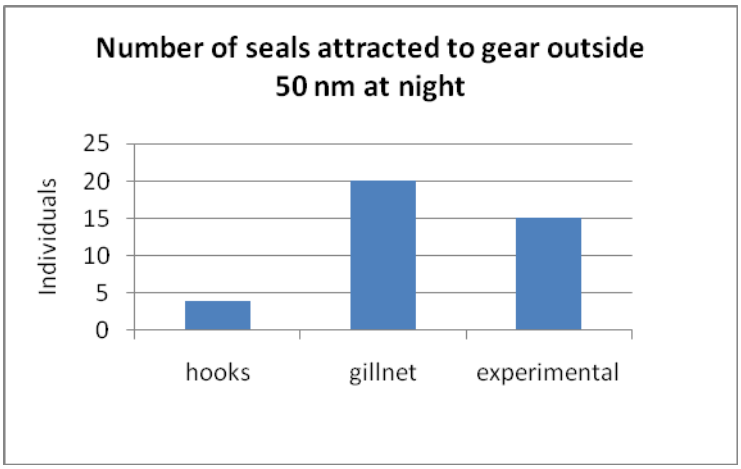
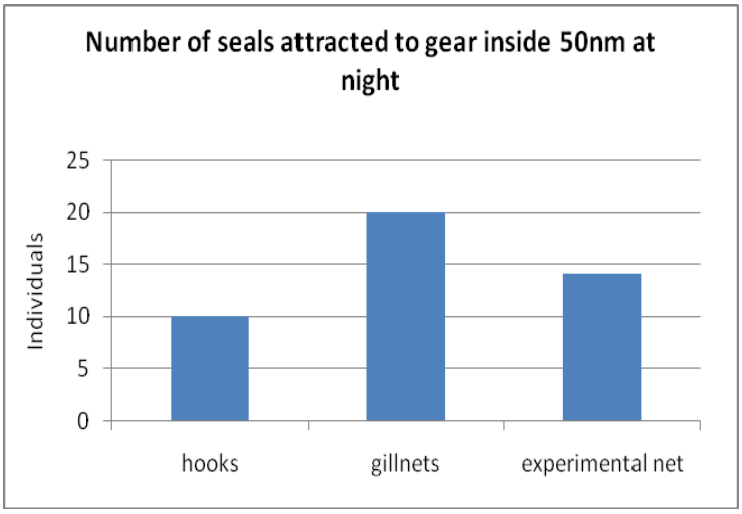


Figure 4 and 5. The numbers of seals attracted to all types of gear inside and outside the 50nm boundary at night.

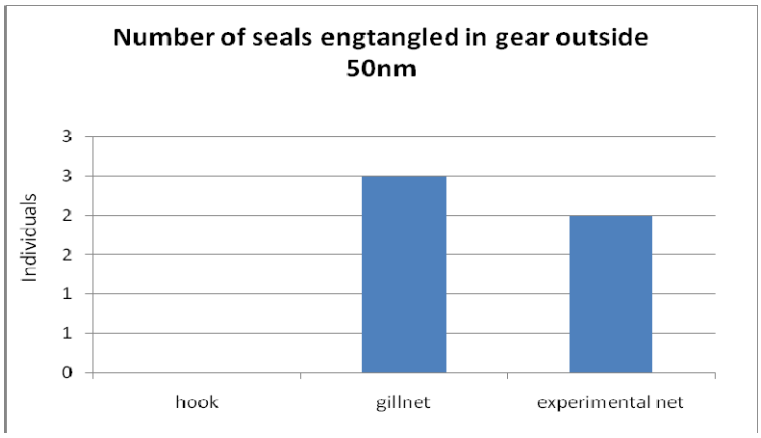




Hook and line gear did not entangle any animals regardless if they were in the boundary or not. Gillnets did entangle animals at low numbers outside the boundary and the experimental net entangled one less animal than the standard gillnet. Inside the 50nm boundary entanglements doubled with gillnet gear. Hook and line gear entangled 2 animals inside the boundary (Fig. 5 & 6). Night sets had a slight increase with entanglements of gillnets, the standard gear catching 1 more animal than the experimental gear. At night hook and line gear entangled seals within the 50nm boundary. The gill

nets caught a couple of more animals at night than day sets, with standard gill nets catching more than the experimental net (Fig 6 & 7).

Figure 6 and 7. The amount of seals that were entangled in all three types of gear inside and outside the 50nm boundary.



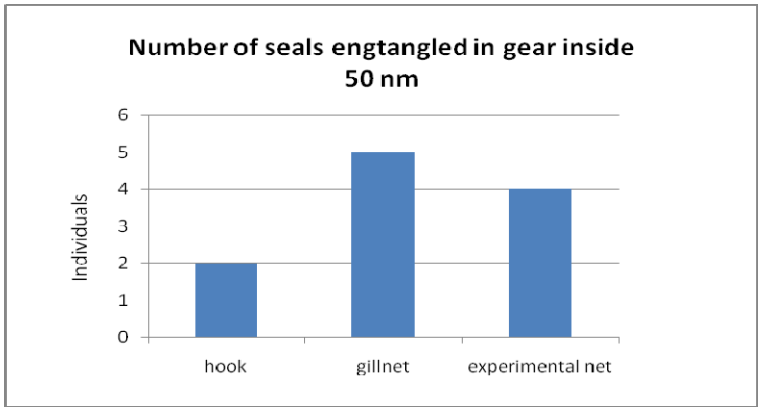
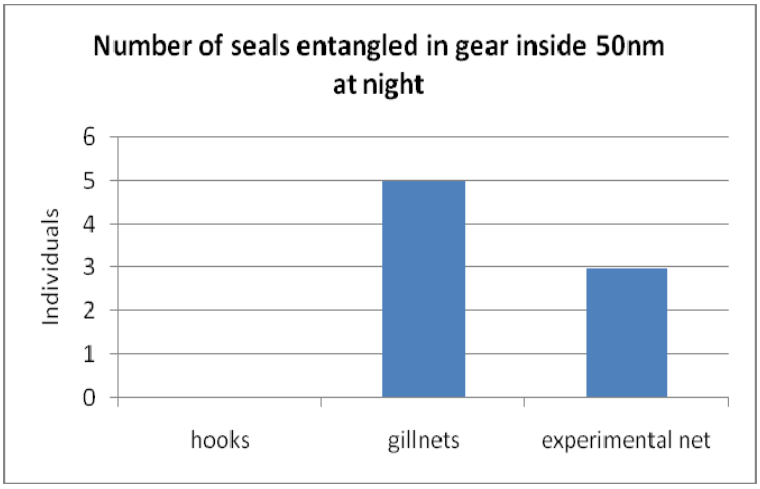
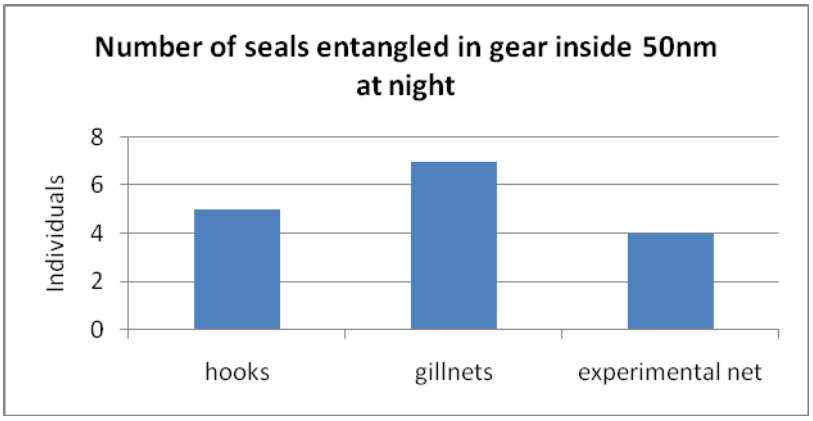


Figure 6 and 7. The amount of seals that were entangled in all three types of gear inside and outside the 50nm boundary at night.





CONTRIBUTIONS

The past five years have shown an increase of Hawaiian monk seals in the Main Hawaiian Islands. The populations seem to be healthy and steadily reproducing. The low number of sharks in the MHI compared to the NWHI that takes some pressure off the seals that has proven to be one of the seals major causes of mortality. However, the NWHI are almost void of human activity compared to the population of the MHI. Most people are aware that they must respect seals when they are hauled out on beaches though there have been a few instances of harassment. Fishery interactions are also expected to increase as the population increases in the MHI, but in these cases monk seals may be seen as competition and not given as much respect.

Certain types of fishing gear including most net fisheries have proven to be a great hazard to monk seals in the MHI (Kobayashi & Kawamoto 1995). Fisheries managers along with politicians have addressed this issue creating stricter regulations and even bans for lay gillnets across the state. New regulations are generally not received well by fishers and they are often disregarded in the absence of enforcement officers. A common misconception of fishers is that they are being unfairly regulated, especially in the absence of scientific data supporting the stricter regulations.

In the year 1990 concerns were addressed that in the Northwestern Hawaiian Islands monk seals were increasing coming in contact with commercial fishing boats by closing fishing within 50nm of certain NWHI and by placing observers on bottomfish and longline vessels. At this time bottomfishers implemented their own mitigation procedures when monk seal and other marine mammals were in the area. The measures

include: pulling up fishing gear anytime there is protected species sighted within a ten yard radius and moving if the animal remains in the vicinity for more than two hours; retention of all injured or dead fish and discards at all times; and only discarding offal after fishing has ceased, and the protected species is not present (MSRP 2007).

However, since fishers in the MHI are not as accustomed to interacting with protected species, implementing mitigation procedures could be seen as overregulation. The data that is collected by this research could provide a scientific basis for mitigation in hopes that fishers will respect and practice any future regulations. The evidence that gillnets are more attractive to seals can be used for the ban of gillnets in Hawaii or stricter regulations and enforcement of current laws.